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RUBBER.

RUSTINESS IN SMOKED SHEET.

Rustiness in sheet rubber has been attributed by various investigators to a superficial formation of resin, or to incomplete coagulation, or to a deposit of some of the constituents of the serum, more especially the proteids, on the surface of the rubber. Research on this problem has recently been carried out by HELLENDORN, and, though he was unfortunately compelled by illness to relinquish his investigation before it was quite completed, the results, published in the ARCHIEF VOOR DE RUBBERCULTUUR IN NEDERLANDSCH-INDIE, 3rd year, No. 9, are of considerable value from the practical standpoint.

It had been noticed that rustiness was especially prevalent during wet weather. In experiments in the laboratory and on estates rustiness could always be produced at will by keeping freshly rolled sheets for some time, twenty-four to forty-eight hours, in a damp atmosphere. Rustiness was produced when ordinary sheets were hung up in ordinary kerosene tins, closed with a tight-fitting lid, in which a small quantity of water had been placed. If the lid fitted loosely, so that the upper part of the tin was more or less ventilated, the parts of the sheet nearest the cover sometimes remained free from rustiness, while the parts nearer the water at the bottom of the tin became rusty.

The degree of moisture in which the sheet hangs shortly after rolling is of the greatest importance. In wet weather, sheets taken immediately after rolling into a drying room at a temperature of 104°—140°F never became rusty, whilst air drying (at room temperature) sometimes produced rustiness.

Rustiness is increased by rolling the sheet a longer time after coagulation. An increase in rustiness was caused in several experiments by rolling the sheets twenty-four hours after coagulation, instead of directly.

HELLENDORN concludes that rustiness is not caused by a film of serum constituents, notably proteins, merely dried on the surface of the sheet, but by the decomposition of the serum constituents by a micro-organism.

It has frequently been noted that when the coagulum is kept in coagulating pans for some time after coagulation (say over night) the side of the sheet which corresponds to the upper part of the coagulum, i.e., the layer

which was exposed to the air, shows rustiness to a greater extent than the lower surface which was immersed in the serum. The explanation of this is that infection may start earlier on the upper surface, and the growth of the micro-organism may be more rapid there, as the organism is aërobic, that is it cannot develop in the absence of air. This may also explain why, in some instances, rustiness has been diminished, where the coagulum is allowed to stand over night, by sinking it beneath the surface of the liquid by means of a block of wood.

The condition of the atmosphere in which the sheet is kept is, however, of great importance, and its effect may equalise or even discount the effect of infection on the coagulum. In the kerosene tin experiments noted above, the side of the sheet which is lowest in the tin becomes more rusty than the other side, even if it was the lower side of the coagulum in the coagulating pan, because of the greater humidity to which it is exposed. In the same way, in actual estate practice, rustiness may appear on some parts of certain sheets only, because these remained moist (perhaps from being hung too close together) during the period immediately after rolling.

The organism responsible for the decomposition of the serum substances has not been isolated, owing to the enforced termination of the experiments. But artificial infection of sterilised sheets has been successfully accomplished by using a suspension of the surface slime which had formed on sheets kept in a moist atmosphere after rolling. The sheets were sterilised by steam after rolling. One of them, the control, kept for twenty-four hours in a moist atmosphere developed only a few rusty spots; the other which was infected by means of a suspension of the surface slime and similarly kept in a moist atmosphere became very rusty.

The micro-organism which is the cause of rustiness needs air for its growth and does not thrive where the air cannot penetrate. This may be shown by simple experiments. For example, when a freshly-rolled sheet is rolled up tightly and placed in a moist atmosphere, only the parts exposed to the air develop rustiness, while the surfaces which stick together, so that the air cannot penetrate, remain free from rust. Similar examples may be observed in the factory. For instance, it may be found that a rusty sheet shows a strip free from rustiness, where the sheet hung closely round the rod; while in other cases, a sheet, otherwise rust free, may show a rusty band where it lay only loosely round the stick, so that a local moist atmosphere was formed at that spot. Rustiness did not develop in air which had been deprived of oxygen.

Like all micro-organisms, that which causes rustiness has an optimum temperature, i.e., a temperature at which it develops most rapidly. This appears to be about 104°F. Sheet kept at 104°F developed rustiness to a greater extent than that kept at room temperature (80°F), but in the experiments cited, rustiness could not be obtained at a temperature of 122°F. There was, however, a possibility that at the latter temperature the atmosphere was not maintained sufficiently moist.

The micro-organism obtains its nourishment from the thin layer of serum substances which remain on the sheet after most of the serum has dripped off, or from the bye-products which are absorbed by the rubber. It appears to prefer a diluted serum rather than undiluted: sheet from diluted latex (rubber content, 15 per cent. or even 5·7 per cent.) developed rustiness to a greater degree than sheets from undiluted latex. Soaking the sheets in water after rolling, so that a great part of the serum substances is removed, does not prevent rustiness: on the contrary, under favourable conditions, rustiness develops on such sheets to a much greater extent. Even on sheets soaked in water for seven days rustiness could be produced.

"It is well known to planters that when sheets are soaked in water, and the very dilute serum so formed is kept for some time, a jelly-like substance develops, as if some grease or fat had been extracted from the sheets. This jelly-like substance is probably very closely related to the substance forming the film of rustiness.

"Of some practical importance is the question whether smoke forms a sufficient disinfectant to prevent the growth of the organisms causing rustiness. When the wet sheets are placed in the smoke house and ventilation is only small, a wet atmosphere may be formed of a somewhat elevated temperature which would be very favourable for the development of micro-organisms, unless the smoke acted as a preventive. From our preliminary experiments it seems that smoke does hinder the formation of rustiness under such circumstances to some extent, but does not wholly prevent it; and, especially in places where the smoke does not penetrate so easily (for instance near the sticks, or in places where two sheets come very close together) rustiness may develop. If however one takes care that the sheets air-dry rapidly, so that they are sufficiently dry when they are placed in the smoke-house, the disinfection by smoke is negligible.

"The simplest way to prevent rustiness in actual estate-practice is to take care that the surface of the sheet dries so rapidly that the micro-organisms, which only grow on the surface exposed to the air and need moist surroundings, have no time to develop. The sheets after rolling and soaking in water should be hung wide-spread, wide apart, in a current of air, even outside the factory under shelter or in a shady place, rather than in a dark, moist corner of the factory; and after dripping for a few hours the sheets should be at once taken to the smoke-house. Leaving the sheets to drip outside the smoke-house for a night should be avoided.

"Prevention of rustiness by disinfecting the surface of the finished sheet with dilute formalin or chinosol is also possible, but as it is not so efficient as to allow rapid surface-drying to be neglected, and as it requires additional cost and work, it is not to be recommended.

"The old method of soaking the finished sheets for some time in hot water, which however as far as we know is no longer in use, is to be discarded, as the quality of the rubber may be injured to a marked degree.

"EATON, GRANTHAM and DAY recommend against rustiness soaking in water, and other measures tending to remove the serum as much as possible and to avoid concentration and drying up of serum by evaporation; they regard rustiness as being caused by a film of dried-up serum-substances. That soaking in water does not prevent rustiness, and that after soaking in water rustiness develops even to an increased degree; and that rapid surface-drying is the best method to prevent rustiness, we stated above. It would seem that the measures recommended by EATON are useful against the defect called greasiness, which (as far as it is not complicated by oversmoking) is caused by hygroscopic serum substances. It may therefore be stated clearly that the drying up of *undecomposed* serum-substances causes greasiness, whilst the *decomposition* of serum-substances results in rustiness. The first defect should be avoided by soaking the finished sheets for some time in water, so that the larger part of the soluble serum-substances from the surface-layers is extracted; and the second defect should be prevented by rapidly surface-drying the sheets after taking them from the water. It may be remarked that rusty sheets, especially when they are not smoked, have a perfectly dry feel, and are never greasy or sticky; it seems that the hygroscopic serum-substances are decomposed during the processes that result in rustiness."

Ribbed sheet has been found to develop rustiness equally with diamond sheet.

T. P.

TEA.

A BASIS FOR TEA SELECTION.

Our readers perhaps do not need to be informed that the cultivation of tea in Java is being supported by a thorough scientific investigation into all aspects of the subject. As was only to be expected from a country which has brought cinchona to the highest standard, and has been foremost in the exploitation of modern coffees the question of varieties and jats of tea has been taken up, in order to ensure that the best varieties possible shall be planted and to effect whatever improvement may be possible in the existing types; and to secure a foundation for this work, Dr. C. P. COHEN STUART has carried out a searching enquiry into all the available evidence. The results of his researches have now been published in the Bulletin du Jardin Botanique (Series 3, Vol. 1, fasc. 4), and cover 130 pages, illustrated with eleven plates. The Bulletin being written in English, the information is immediately available to all interested in tea in other countries. It fully deserves its title of "A Basis for Tea Selection."

DR. COHEN STUART opens with an account of the introduction of tea planting into India, Ceylon, and Java which is the most complete and authoritative that has yet been written. He goes fully into the reasons which induced the Indian advisers to introduce China tea, and holds that, under the circumstances and in the light of the information then available, it was the only possible course. Full references are given to documentary evidence, and this history will no doubt remain a standard work of reference on the subject.

His remarks on Ceylon, respecting the introduction of tea, are not particularly flattering, but it may be as well as to see ourselves as others see us.

"Ceylon is a tea district of a comparatively recent date, having known the tea plant only in a cultivated state (we will see in the third chapter, that the assertion, sometimes heard, that tea has been found wild in Ceylon, is incorrect). The first experiments were carried out as early as 1839, but the first plantation dates from 1867. In the latter year, there were only 10 acres (4 hectares) planted; 10 years afterwards, in 1877, 2,720 acres (1,100 hectares); in 1887, 170,000 acres (68,800 hectares). This rapid increase, the so-called "rush into tea," was caused by the coffee blight *Hemileia* making its appearance between the years 1870 and 1880 and ruining this culture; all coffee plantations were then planted with tea. The production of tea kept pace with this advance; in 1873 it came to 23 lb., in 1883 to 1,500,000 lb. These figures strikingly illustrate the tremendously rapid increase within 20 years, and it is quite obvious that, in order to supply the unequalled demand for tea seed, inferior sorts of seed were bought wholesale in the north-eastern provinces. The consequence has been that Ceylon tea is an awful medley of tea hybrids, and that Ceylon, as a seed-producing country, stands in very bad repute among Java planters, however good its manufactured tea may be."

DR. COHEN STUART, however, does not take into account the fact that many tea seed gardens in Ceylon do not date from the first rush into tea, but have been planted in recent years with recognised jats, though considering his following remarks on selection, he might contend that the position was not materially altered thereby.

"Carelessness about the variety of tea planted, carelessness about the precious wild tea tracts, carelessness about the management of seed gardens, carelessness in short, about all measures that were liable to secure an effective tea selection, such, I regret to say, has been the happy-go-lucky attitude of the British planters towards a matter that could not, indeed, yield immediate profits, but should undoubtedly have done so at one time or another. Nor did they lack good counsel, for SIR GEORGE WATT has, ever since 1882, endeavoured to re-organize the Assam seed-gardens. This meritorious promoter of tea cultivation in India had the kindness to inform me in what way the seed gardens were managed in the beginning :

"'When I first made a tour through the tea districts of India, I found seed production very much a matter of accident. Most seed gardens were found to contain several different plants.' That is, he explains, 'several distinct races of plant *including the China. These had been introduced with the object of being able to supply* (as it was thought) *whatever stock might be desired*.' A naive idea, to be sure ! 'I suggested to the owners that they should eliminate all but one and endeavour to justify the reputation of each seed-garden as producing a definite and characteristic race of its own. My recommendation was adopted by most seed growers with the result that Bazelona, Singlo, Tingri, Namsang, Kalline, etc., are well-known and specially recognised stocks of the so-called 'Assam Indigenous.'"

"However important a progress this measure was, selection proper seems never to have been practised in India, though WATT repeatedly urged the necessity of it, especially of crossing experiments with other *Camellia*-species. But nobody has taken up this suggestion. The only thing the planters have done of their own accord, is, the substitution of many China plantations by indigenous varieties, because they gradually recognized the superiority of the latter. But this superiority is not universally accepted, and, as a matter of fact, the Himalaya districts furnish a conclusive proof that, under certain conditions, China tea may be the better variety. Everywhere, however, it has left indelible traces in the shape of innumerable hybrids, even where they are most certainly inferior."

After discussing the history of tea cultivation in China, the author next endeavours to trace the original home of the tea plant. Here he finds two difficulties : one, that what has been recorded as wild tea is often not tea at all, as in the case of BENNETT'S record of wild tea in Ceylon, and the other, that so-called wild tea, which is really tea, is frequently found to occur in the neighbourhood of old caravan routes, sometimes in regular blocks, and is to be regarded rather as an abandoned cultivation. His conclusions are :—"That there exist *at least* two morphological *groups* of tea plants, one of which is indigenous to China, the other to India, while there is not the smallest evidence supporting the idea of any direct genetical or genealogical affinity connecting them. Perhaps, as we shall gather from chapter V, even four groups may be distinguished (to wit, 1: Manipur, Cachar, etc., 2: Assam?

Burma and Siam, 3: Tong-king ? Yun-nan and Szechuen, 4: Eastern China); and, though migration and consequent hybridization through human wanderings are very probable, those groups seem to have held out in spite of that, rather than to have been evolved by means of the displacements, which tended to level all existing differences. How, indeed, these differences originated, we have not an inkling of it, nor are we likely ever to find it out."

Coming now to the fundamental part of the memoir, viz., the classification of the known forms, species or varieties of the tea plant, DR. COHEN STUART has examined the greater part of the specimens which have been gathered by botanical collectors, and are now stored in the herbaria of Europe and Asia. Many of these had been collected in a "wild" state and had been recorded as different species. DR. COHEN STUART gives tables showing the differences between these supposed species and varieties, and discusses the question of their validity. We quote his closing pages on this point :—

"Two important questions, still, remain to be settled : Ought all forms of tea to be united unto one species, and if so, which name ought this species to bear ?

"The first question as to the classification of the tea varieties, is, like that of the *Camellia* species, a very thorny one, as it is materially affected by our conceptions on the nature of systematic distinctions, and our decisions will turn out quite different according as we happen to belong to the class of 'lumpers' or to that of 'splitters,' as BATESON puts it. Now, although agreeing with this author that genetical analysis has a bearing on systematics and may modify our conceptions on "blood-relationship" in a degree, I certainly cannot concur with him where he wants to base our so-called natural system on genetic tests exclusively, and accordingly encourages systematists to serve science by giving names freely 'and by describing everything to which their successors may possibly want to refer, and generally by subdividing their material into as many species as they can induce any responsible society or journal to publish.' This extreme 'splitting' as well as the obligatory genetical analysis would render the whole business of classification a mockery, the exact determination of a given specimen practically impossible. On the contrary, considering systematics from a purely opportunist point of view, apart from any pretentious evolutionary theory, I think 'lumping' is the only practical means of cataloguing the existent forms of living beings without having to await the results of an intricate cross breeding procedure. How, indeed, could we henceforth class any rare or extinct form.

"As to the other category of extreme 'splitters' consisting of those enthusiastic systematists whose ambition cannot be appeased before their scrutinising eye has detected the largest number of *novæ species* amongst the poorest material available, I think naturalists never can be too strenuously cautioned against their fatal activity. This scourge of systematic botany compels future generations to manipulate their fabric and drives them nearly to despair when trying to make head or tail of those deficient diagnoses.

"With respect to the forms and shades of tea, it cannot possibly be denied that there exists profound diversity in characters between the *extremes* of the series running from small-leaved China type and large-leaved

Lushai indigenous. In fact, a judicious choice of the proper forms so as to prove what one *wants* to prove, may present the following points of divergence.

China.	*India.*
Bush dwarfed.	Tree, loosely branched.
Flowers early and richly.	Flowers late and poorly.
Leaf rarely larger than 9 × 3 cM.	Leaf generally larger than 12 × 4 cM.
Lateral veins 8-10 pairs.	Lateral veins 10-14 (−22 ?) pairs.
Relative number of serrations generally above 30.	Relative number of serrations generally under 30.
Top leaf often reddish tinged.	Top leaf green or yellowish green.
Leaf surface as a rule smooth.	Leaf very often uneven (bullate).

"Now, supported by such diagnoses as the above, we may readily constitute two well-characterised species of tea. The difficulty begins when intermediate forms have to be classed. And intermediates are more frequently found than types, being either genuine or supposed hybrids or wild-growing plants. Is the leppett tea, is the P'u-êrh tea-plant, is HENRY'S remarkable specimen, Chinese? are they Indian? are they *bohea*, *viridis*, *macrophylla*, or are they separate species every one of them? Crucial questions! I prefer naming them tea, to cut it short.

"It is, certainly, a personal view, based on the *'vague notion'* of a species meant by DARWIN, rather than on the exact definition dreamt of by some modern geneticians; and that botanist, who could scarcely believe all specimens in WATT'S herbarium to belong to one and the same species, may have appealed to that same 'vague notion' in support of his view. But I think if this naturalist had also been acquainted with the other *Camellia*-species, and if he had known the very isolated position of the *Thea*-section as compared with the other Camellias, he would possibly have felt an equal apprehension of subdividing this *relatively* homogenous morphological group.

"There are, besides, more practical reasons for uniting all forms of tea. The commercial seed types, 'Landsorten' they might be called, are anything but well-defined varieties; they present a stupendous mixture of the most diverging leaf shapes. It would be a hopeless task to sift them according to LINNEAN species, which are besides mere abstractions, whereas their description by purely statistical methods is not, in principle, impracticable. Moreover, everybody understands that the word 'tea' means *any* variety of tea as long as no form is expressly mentioned by name.

"The latter line of argument is supported by the subsequent curious reasoning. If a new form of *Camellia* is met with, how are we to make out whether it is a 'tea plant' or not? We may of course limit this conception by botanical distinctions. But we know that WALLICH did so and accordingly declared the Assam *Camellia* not to be a tea plant; but when it proved to yield genuine tea, he had to come round and formulated a wider diagnosis. We may on the other hand consider the tea-yielding faculty as the essential characteristic of a 'tea plant.' But then, what is tea? The beverage containing caffein, tannin and aromatic constituents, prepared from *Ilex paraguayensis* and known as 'yerba maté,' a tea-substitute.—is it tea? and a tea-like extract from a *Camellia*-species with a bitter or acid constituent,—would not it be? Clearly we would go too far if

we identified all *tea-yielding* plants with *tea* plants, and not far enough if we confined ourselves to the botanical characteristics available at the present day. So, any diagnosis will needs lack definiteness; but this much we may safely infer, that it is undesirable to make the specific limits much narrower than the limits assigned to the tea-producing capacity.

"I have therefore decided in favour of one single collective species, including all tea plants under cultivation.

"Now, what name must we adopt for this collective species? I propose the name placed at the heading of this chapter, to wit, *Camellia theifera* (Griff.) DYER and such on the following grounds:

"This name was used for the first time by GRIFFITH, who applied it to the Assam tea plant in contradistinction from China tea *('C. bohea.')* As a collective name for all tea forms it was used in the first instance by THISELTON DYER (1874). According to the 'International rules,' cited in the 5th chapter, art. 43, this increased significance is equivalent to the creation of a new species, and both authors are to be quoted in the manner shown above.

"It should be observed, however, that a *strict* application of the aforesaid Rules leads us to another deduction. Indeed, *the first name intended for all tea forms jointly was Thea sinensis L.*, so that *Camellia* being the correct generic name *Camellia sinensis* should henceforth be used for the collective species embracing all the forms known in *Linnaeus'* time and those then yet undiscovered, according to art. 44. It was actually, and I must own, correctly employed by O. KUNTZE in 1881, and again in 1887 (p. 195); he afterwards rejected it (1891, p. 64,) but on arguments not available. F. MASON (1883, p. 633) also makes use of this name.

"However correct the denomination *Camellia sinensis* (L.) O. KUNTZE. may be, I do not think it advisable to adopt this very unusual name. We may object. (1) that the expression *'sinensis'* does not suit large-leaved *Indian* teas; (2) that LINNÆUS in 1753 knew but one form and soon subdivided this species, so that we may take it for granted that he would not have applied the name *sinensis* on the Indian forms; (3) that this name cannot properly be qualified as the first denomination which comprehends *all* forms of tea, since the union was not actually effected before DYER. Neither of these arguments are, to be sure, valid in the sense of the nomenclature rules. The case is rather doutful, but I prefer *C. theifera*, this name being more 'classic' than *C. sinensis*.

"On the contrary, we need not feel the least doubt with regard to the name *Camellia Thea*, which is quite certainly incorrect. We meet with it for the first time with LINK (1822), who used it to designate *Thea bohea L.*; BRANDIS (1874) was the first, KURZ (1874) the second to apply it in the sense of Chinese plus Indian tea. But THISELTON DYER had got the start of him and chosen the name *C. theifera* for the same combination; accordingly, BRANDIS mentions DYER'S synonym, not conversely. Though the term *C. theifera* was published only a few months before *C. Thea* this of course suffices to deprive the latter of its priority.

"We may summarise all questions connected with the nomenclature of tea in the following terms:

1. The generic name *Thea* is certainly incorrect. *Camellia* is the sole exact name.

2. *Thea sinensis* (*L*) SIMS has therefore certainly become obsolete; *Camellia sinensis* (*L*) O.K. is in accordance with the international rules, but LINNE'S denomination of 1753 did not include Assam tea.

3. *Camellia Thea* (*Link*) *Brandis* is certainly to be excluded, since the union of China and India tea was earlier effected under the name *C. theifera* (Griffith) DYER.

4. It is desirable to use *C. theifera* instead of *C. sinensis*."

T. P.

FOODSTUFFS.

UPLAND RICE.

The term "upland rice" is applied to those varieties of rice which grow in ordinary well-drained fields during the rainy season.

Such rice may be grown wherever corn or sugar-cane will grow or on newly opened lands.

In the growing of this kind of rice several factors which are *primarily essential* to the production of *lowland rice may be dispensed with, the most notable being the artificial water supply and the carabao and puddling operations.*

Upland rice is suitable therefore for general extensive growing on new lands. From investigation and experiments it has been conclusively proven that upland rice will yield much more per hectare than any variety of lowland rice tested.

Average production as compared with lowland rice shows that for every 100 cavans produced in paddy, 117 cavans are produced in dry field culture of the same areas.

Figures tend to prove that the lowland rice most farmers are raising is much less productive than upland rice would be while the production of lowland rice entails more labour, time and expense and proves conclusively that our Filipino farmers have been labouring under a delusion all these years, and are wasting time, energy and money in this present method of rice production.

The introduction of improved methods of growing upland rice will bring vast areas of unirrigated land into use, while if grown in rotation with sugar and corn will become an even greater source of profit, and keep down the annual crop of weeds, which is allowed to develop regularly under present methods.

Improved lowland varieties alone have proven inadequate to supply our present needs and require carabaos and large quantities of artificial water supplies, neither of which are abundant at present.

Machinery can be used exclusively for growing upland rice, and irrigation is no more needed than in the growing of sugar-cane.

The best varieties of upland rice mature in from 120 to 135 days, or during the regular rainy season, which gives more than 30 days more time for plowing and preparing to raise the crop.

Where the ground to be planted with upland rice is thoroughly prepared, this variety grows fast enough to smother grasses and weeds and is sufficiently strong to stand up well and to a great degree resist the effect of the wind.

Many varieties of upland rice will average yields of 50 cavans per hectare on properly prepared land, while the average production of rice for the entire Philippines for the year 1918 was only 26·16 cavans.

An investigation of this idea of growing palay on a much more extensive scale will lead to a decided improvement in the food situation.—PHILIPPINE FARMER, Vol. V., No. 9

RICE PRODUCTION IN CALIFORNIA, U. S. A., AS COMPARED WITH RICE PRODUCTION IN THE PHILIPPINES.

The first commercial crop of rice in California was grown in 1912 in the Sacramento Valley.

The profits from this crop of 600 hectares were so large that wide publicity was given to the possibilities of rice culture and 2,500 hectares were planted in 1913.

The average yield of 3,200 lb. per acre or 64 cavans per hectare, gave so great an impetus to this industry that over 6,000 hectares were planted the following year and added to the agricultural wealth of the state over $1,600,000 in the first four years of this industry. Such men as H. O. JACOBSON of the Bureau of Agriculture, were secured by salaries greater than this Government thought it could pay them to develop this industry, and later on another of this Bureau's best men, A. M. BURTON, then chief of the Plant Industry Division, was secured in the same way.

With such men as MESSRS. JACOBSON & BURTON, with others from California to lead the way, it is no wonder that the rice industry of that State has gone forward by leaps and bounds and that fortunes have been made in the production of rice.

All of this work has been done by the use of modern machinery and modern scientific methods of farming, using tractor motors for planting, disking, seeding and harrowing and the regular threshing machines for threshing.

Here is what the CALIFORNIA AGRONOMIST says: When not contrary to good farm management, *plowing should be done in the fall and deep plowing should be practised.* The action of the weather will reduce the clods and make disking and harrowing and the preparation of a good seed-bed, easier the next spring.

The vigorous growth of the young plants, as well as high germination, is dependent upon how well the soil has been prepared for seeding.

Only selected seed should be planted and better results are obtained by drilling the seed than by broadcasting.

Rice sown on ordinary ground should not be drilled in deeper than two inches and well covered.

Early planting is desirable and the average early varieties will generally prove most reliable.

The levees should be just high enough to hold back the water and broad enough so that all kinds of machinery may easily pass over them.

The water will not become stagnant if freshened every 10 days.

The worst weed of the rice fields of California is red rice, and its presence in the rice of commerce always lowers the value

A field of ripe rice should be drained as quickly as possible in order to harvest the crop at the least expense of time and labour, so as to prevent the loss of the ripened grain.

As soon as possible get to work with the binder.

A twine binder should be used in cutting the crop, which is ready to harvest when the kernels on the lower part of the head are not entirely hardened and the heads turn down.

Make shocks of about 10 or 12 bundles and cap well to keep out rain and sun but leave plenty of air space, and leave from two to three weeks for drying.

The following table gives the cost of growing one hectare of rice in the Sacramento Valley of California where money is made yearly even at these prices.

TABLE OF COSTS.

	Acre.	Hectare
Plowing	$3·00	$7·50
Preparing seed bed	1·25	3·25
Checking	2·60	6·50
Drilling	·75	1·875
Boxes	·50	1·25
Seed rice	2·00	5·00
Care of crop 5 months ...	4·00	10·00
Twine	·40	1·00
Harvesting	2·25	5·75
Shocking	1·00	2·50
Threshing	7·00	17·50
Sack and sewing	3·50	8·75
Hauling to warehouse ..	1·75	4·375
Water tax	5·00	12·50
Keeping down weeds ...	1·25	3·25
	36·25	91·00

or 182* per hectare for 70 cavans, or 2·59 per cavan,—the cost of production and transporting to warehouse in California—while here in the Philippines from the statistics of the Bureau of Agriculture we find the cost of growing one hectare under present methods to be 98 per hectare for an average production of only 26·16 cavans or at the rate of 3·75 per cavan by present methods as against 2·59 by modern methods and machinery. These figures are taken in both cases from the most reliable sources, the Government of the U. S. of America and the Bureau of Agriculture of the Philippines. With such figures no other argument is needed to see the necessity for a change in our methods of producing rice in the Philippines.

Our present methods have proven inadequate to our needs and far too expensive to be continued, when the rice can be produced by more modern methods for 1·16 per cavan cheaper than we now produce it.

If this saving could have been made on the rice produced last year—35,795,045 cavans—our wealth would have been increased by the sum of 41,521,352.*

There is no reason why the Filipino cannot be taught this money-saving and advantageous way of raising this staple food product.

Let the Government undertake this modern method, already proven successful in California and other rice growing centres, and demonstrate the practicability of raising rice, on idle, unproductive lands if necessary by the use of modern machinery, and if successful, it will not be long before every rice grower would adopt this method. Our land is as rich, or climate certainly as good for rice growing and the people surely can learn how, *if the Government will only lead the way.*

If 70 cavans of palay could be produced per hectare, as is done in California, the present area devoted to rice would produce 95,769,800 cavans of palay, enough for 5 cavans per capita for food and 45,769,800 cavans for export worth 228,849,000.*

Isn't it worth trying for?—PHILIPPINE FARMER, Vol. V., No. 9.

* Filipinos=50 American Dollar cents.

A DRIED-BANANA INDUSTRY.

The Imperial Department of Agriculture for the West Indies has been in communication with the Colonial Office concerning the possibilities of extending the dried-banana industry in these islands, an industry which so far exists only in Jamaica.

Last December, the Imperial Commissioner of Agriculture requested the Agricultural Superintendent, St. Lucia, to prepare small samples by means of a Chula drier employed there during the war in connexion with the food campaign.

Samples were prepared in due course and forwarded to Barbados, but they turned out to be valueless on account of the excessive drying to which they had been subjected.

Further trials were made in due course. Ripe bananas were simply peeled, not sliced, and gently heated at a temperature of about 150°F. for sixty-four hours, until they reached a firm consistency, care being taken to provide ventilation, which is very essential. Another sample was dried in the sun.

Both these samples have been pronounced to be palatable articles of diet in Barbados, and large quantities forwarded to the Imperial Institute London, for commercial valuation, have been reported on favourably too This report is published as the conclusion to this article.

As regards the cost of producing dried bananas in St. Lucia, MR. A. J. BROOKS, the Agricultural Superintendent, has furnished the following information. In the second trial referred to above, 30 lb. of ripe bananas were used. The skins when removed, weighed 7½ lb., thus leaving 22½ lb. of fresh banana. The dried bananas weighed 6½ lb. On this occasion the bananas were purchased at 1*d*. per lb. The original cost was therefore 2*s*. 6*d*. If the dried product of this trial sold at 6*d* per lb. on the spot, without further charges of packing, freight, etc., it would, in MR. BROOKS' opinion, just about pay. The dried product at 6*d*. per lb. would realize 3*s*. 1½*d*., leaving a difference of 5½*d*. per lb., which sum would have to cover labour in handling, loss from decay, and cost of fuel. If large quantities were handled, the cost of drying and handling would be greatly reduced. In this connexion the report of the valuers in London that the sun-dried fruit are better than the artificially-dried is important.

There is little doubt that with a good supply of sound fruit at about 1*d*. per lb. and the sun-dried products disposed of at 6*d*. per lb., a profitable industry could be established in the West Indian islands.

The following is the report on the samples from St. Lucia received from the Imperial Institute :—

Description of Samples.—The samples consisted respectively of sun-dried and artificially-dried bananas.

"The sun-dried bananas were in excellent condition, pale in colour, and of good appearance, except that the netting used as a support during drying had produced deep markings in the fruit.

"The bananas which had been artificially dried in a drying apparatus were distinctly inferior to the sun-dried sample. The fruits were very dark in colour on the side which had been in contact with the netting used as a support, and this defect would detract from their value.

"*Commercial Valuation.*—The samples were submitted for valuation to fruit merchants in London, who considered the sun-dried bananas to be of good quality and worth 6*d.* per lb. wholesale in the United Kingdom (July 1919).

"The flavour and quality of the machine-dried bananas were pronounced to be quite satisfactory, but such dark coloured fruits would probably not be saleable when lighter fruits like the sun-dried samples are available. If, however, the darkening in colour could be avoided, they would be as valuable as the sun-dried bananas.

"These dried bananas from St. Lucia are somewhat larger than those now selling in the United Kingdom. The latter fruits are of about the same colour as the sun-dried sample, and realize 6*d.* or 7*d.* per lb. wholesale, whilst some lighter-coloured fruit have recently been imported and are being sold at prices ranging up to 10*d.* per lb.

"Before the war dried bananas sold at 3½*d.* per lb. wholesale in the United Kingdom, but during the war the price reached 2*s.* 6*d.* per lb. The importation has rapidly increased, but the future demand and price will depend upon the price of fresh bananas, which at present is high. When abundant supplies of cheap fresh bananas again become available the demand for the dried fruit will fall but there will always be a certain outlet for them as the trade has now become established.

"*Remarks.*—These sun-dried bananas from St. Lucia are of good quality, and consignments of similar character would be saleable in the United Kingdom. The artificially-dried fruits were inferior to the sun-dried on account of their dark colour, and it would be desirable to carry out experiments with a view to obviating this defect. The lighter the colour of the fruits, the higher will be their market value in the United Kingdom.

"It is not advisable to pack bananas in ordinary paper as it adheres to the fruits, and 'biscuit' paper or some form of greaseproof paper would be more suitable. It may be mentioned, however, that dried bananas usually arrive on the United Kingdom market in wooden cases, each containing cwt. of bananas packed in layers without any wrapping material.

"The fruit merchants who valued the samples stated that they would be willing to receive a trial shipment of about ten ½ cwt. cases of dried bananas from St. Lucia, provided that the quality was not below that of the present sun-dried sample. Information should therefore be furnished to the Imperial Institute as to the possibility of forwarding this quantity for sale."

Steps are being taken to supply the valuers in London with the large quantities asked for.—AGRIC. NEWS, Vol. XVIII, No. 453.

ARROWROOT CULTIVATION.

W. MOLEGODE, S. A. I.

There is very little arrowroot grown in Ceylon.* Why that it should be so one cannot understand as the cultivation is a simple one and the hand preparation of the arrowroot flour can be done by village women—the process being the same as the preparation of kitul flour. The following notes are written in the hope that the cultivation of arrowroot will be taken up in our villages and made a paying industry. Sometimes locally prepared arrowroot flour of a decidedly good quality is obtainable in the bazaars.

The commercial product arrowroot is obtained from the underground starchy rhizomes, tubers or bulbs of the plants *Maranta arundinacea* and *Canna edulis*. Both these are well known in Ceylon and are to be seen growing well in most parts of the Island up to 3000 feet elevation. The Sinhalese names of the former are *Araluk* or *Hulankiriya* and the latter *Butsarana*. [Hulankiriya is properly *Phrynium zeylanicum*, and Butsarana *Canna orientalis*.—ED.] The tubers of both species are boiled and eaten. Though arrowroot obtained from the tubers of both the plants is so much alike, there being hardly any difference noticeable, the plants themselves differ considerably from each other. The Maranta, commonly called the Bermuda or the true arrowroot, produces white tubers of a moderate size with thin shiny skin free of roots. The *Canna edulis*, commonly called Queensland or Australian arrowroot, produces bulbs of a purple colour in a compact mass and is a much heavier yielder. The plants themselves differ in size and colour. The *Canna* or *Butsarana* grows to a good height often 6-8 feet. It has large broad leaves of purple colour and becomes a bush of great size. Its flowers are like those of ordinary Canna. The *Maranta* is a smaller plant and does not grow higher than 3 or 4 feet and has not got such a tendency to spread as *Canna edulis* and the yield per acre is much less. It has been found out that there is little actual difference between the commercial product of the two varieties, the quantity of starch, which is the chief requirement of arrowroot, being in Bermuda or Maranta variety 82·24 and the Queensland or *Canna* variety 81·52.

CULTURAL NOTES.

Both the species are cultivated alike except that *Canna edulis* has to be planted giving double the space given for Maranta.

Soil.—A light loamy well-drained soil is the best. In clayey and wet lands the rhizomes will not develop properly. As the crop is an exhausting one the richer the soil the better it would be.

Climate.—The plants will grow from sea level to 3000 ft. above. A

[* The cultivation of arrowroot was urged by MOON in 1824, without much result. More recently, it was grown in the neighbourhood of Colombo, and arrowroot was prepared at the Colombo Prison.—ED. T.A.]

moderate rainfall will give the best results but change of weather does not affect this crop very much.

Propagation and Cultivation.—Propagation is by means of young shoots or small bulbs. The land should be cleaned and well dug up and planted in rows of 3 feet apart and 18 inches in the rows (for Maranta) at the commencement of the rainy season. In the early stages of the growth the soil may be turned and drawn towards the plants. When the plants are well established the leaves will cover the ground and prevent the growth of weeds. Very little attention is necessary after this.

Harvesting.—The rhizomes are fully grown in about eight to nine months in the case of *Maranta* and little earlier in the case of *Canna*. The maturity of the rhizomes is indicated by the flagging and falling down of the leaves. When this occurs the crop should be lifted. If the crop is not raised in good time the bulbs will begin to shoot and the yield of starch will consequently be lessened. Too long exposure of the bulbs will have an injurious effect on the colour of the prepared arrowroot and therefore only such a quantity as could be dealt with should be lifted up. Arrowroot, like Ginger and Turmeric, can be left in the soil for two seasons and where this is done the second year's crop is of a better quality.

PREPARATION.

The rhizomes after being cleared of adhering earth should be well washed and roots and the outer skin completely removed and again washed. There are various methods adopted to obtain the starch, but the following is the simplest and easiest to be adopted in the villages as it is the process of extracting kitul flour to which the upcountry villager is quite used. A good supply of pure water is essential in the preparation of arrowroot and such should be close at hand. The first thing is to pound the cleaned tubers in a wooden mortar and reduce them to a pulp. A tub covered with a calico cloth must now be provided and this filled up with clean water. The calico should be so tied as to allow the water to come through it. The pulp is put on the calico and worked round and round with the hand till only the fibrous parts of the tubers are left, and the whole of the farina is suspended in the water. The calico is now removed and time allowed for the starch to settle down. The water is then removed and a fresh supply of water is added, well stirred with the starch and passed through another calico. This process should be repeated until the water over the starch is perfectly clear, when the farina is removed and dried in the sun on clean calico. Care should be taken not to expose the starch to rain as it will get discoloured.

Yield.—The average yield of tubers per acre may be put down at about 10 to 12,000 lb. for *Maranta* and anything up to 20,000 for *Canna edulis*. The amount of starch is about 15% of this weight and therefore the average return of a good crop would be between 1500 to 2000 lb. of arrowroot of commerce.

PEA NUT OR GROUNDNUT.

Wm. HARRIS, F. L. S.,

Superintendent of Public Gardens and Plantations.

The Pea nut, known also as Groundnut, Earth nut, Monkey nut, Pindar etc., is a leguminous plant known botanically as *Arachis hypogæa* Linn.

It has been so widely disseminated throughout the tropics, sub-tropics and temperate regions of the world that its native home was for long in doubt, but all evidence on the subject now points to Brazil as its native habitat.

Description.—The plant is a prostrate annual herb with abruptly pinnate leaves each with two pairs of leaflets. The flowers are yellow, more or less clustered in the axils of the leaves. After the fall of the flower the very small ovary is raised upon a stalk which in time attains a length of several inches and in its growth curves downwards, so that at length the small ovary at its extremity is thrust into the soft ground where the pods are ripened. Should the ovary by some accident not be able to enter the ground it withers and does not attain perfection.

Soil.—A well-tilled, light, sandy soil which contains a fair proportion of lime is considered best. Low-lying, wet soils are unsuitable, and heavy, dark soils which are largely impregnated with iron produce stained nuts which are not of high grade for retailing purposes. For purely agricultural purposes the colour of the shell is of no importance, and in many cases in the United States the largest yields of nuts have been obtained from soils of a rather heavy and somewhat retentive nature, soils with a good deal of clay.

Preparation of the Soil.—The land should be ploughed or forked to a depth of about nine inches and thoroughly broken up, and if there is a considerable amount of vegetable matter in the land it should be ploughed or forked in. If the pea nuts succeed a crop which had been manured so much the better; indeed, it would be good practice to follow a crop of yams or sweet potatos with one of pea nuts.

Seed.—One of the most important points in connection with the cultivation of pea nuts is the careful selection of seeds. Those persons who pay special attention to this point are liberally rewarded for their attention. Only seed from vigorous, productive plants should be planted; the result of planting a miscellaneous collection of seed is an indifferent crop.

It would be well for anyone starting this cultivation to import good seed from the United States.

Planting Season.—The time for planting is before the rainy season, May or June. A moist condition of the soil is essential for the germination of the seeds and growth of the young plants.

Planting.—The nuts are shelled and the seeds are usually planted about eighteen inches apart in rows three feet asunder. About two inches deep is sufficient for the seeds in moist soil, but in dry soil they should be planted three inches deep, the soil being gently pressed down with the feet after planting.

At the distance named 9680 nuts would be required to plant an acre.

Where implemental tillage is not possible closer planting than above may be practised, say eighteen inches by eighteen inches and at this spacing over 19,000 nuts would be required to plant an acre.

Cultivation.—When the plants are about two weeks old it will probably be quite time to hoe the weeds and loosen the soil round the plants, and this should be constantly attended to, the object being to keep the soil mellow and loose, and clear of all weeds. Hoeing should only cease when the pea-nut vines have met from row to row.

Time to Mature.—The ordinary variety grown in the West Indies takes from four to six months to mature its pods, but some of the American varieties come to maturity in about three months.

Harvesting.—When the pods are ripe the plants are dug up and the nuts picked off by hand.

In America, the plants with the nuts attached which are thrown in windrows by the diggers are taken up, gently shaken and placed with the nuts all inside the heap and packed round a pole, making a narrow upright shock about two and one-half feet in diameter at the base, and of nearly uniform diameter until near the top, where it is quickly drawn in and capped with hay or grass. These shocks are about five feet in height.

The nuts are allowed to remain in the shocks until they are thoroughly cured or until they are ready for picking. In some cases the shocks are lifted and carried to suitable buildings or sheds where the picking is done, but in the majority of cases the picking is done in the field.

The nuts are thoroughly cured, and are then placed in sacks and sent to a cleaning factory where they are put through a number of processes for removing all adhering sand and dirt, blanching the shells of those which are slightly discoloured, and polishing those of high grade which are to go on the market for roasting purposes. The brightest and soundest pods should be kept separate, the dark and immature pods being kept together and empty pods rejected with the vines to make hay.

Yield.—It is stated that in Barbados 2,000 lb. of nuts per acre is regarded as a fair average yield, whilst returns of 4,000 lb. per acre are not unknown.

In Virginia and North Carolina the average yield is about forty bushels per acre, but some growers make an average of one hundred bushels per acre with select types of large nuts, and yields of one hundred to one hundred and forty bushels per acre are reported for the Spanish nuts.

Uses.—Peanuts are put to a great variety of uses. Every one is familiar with the roasted nuts for eating out of hand. Great quantities are thus consumed. In addition, the nuts are manufactured into a great variety of confections and candies, while the vines, either with or without the nuts, are valuable for stock-feeding, and the growth of the plant is important in soil-renovation.

Peanut oil is one of the best known vegetable oils, but because of its high food value, quality and keeping properties, it has found little use in the arts. It is used chiefly as a substitute for olive oil. Marseilles is the great peanut oil factory of the world, the supply of nuts being drawn largely from Africa, India and Spain.

As a forage crop, the peanut vines make hay possessing a feeding value for cattle, mules and horses equal to that of clover hay. The yield of hay when the crop is well manured and cultivated ranges from one to three tons per acre. The value of the forage is each year becoming better recognized, and more careful attention is being given to harvesting the nuts in such a way as to preserve the hay in the best condition for feeding purposes.—

MUNGO ON RICE LAND.

For rotating with lowland rice there is perhaps nothing better and more convenient to the farmer than mungo. The seed is easily obtained and grown. Mungo is a wholesome food, well liked by all classes of people, and there is at all times a ready market for any surplus product that the farmer may have. The mungo crop may be grown without the farmer incurring any extra expense for plowing, irrigating, or otherwise preparing the land, provided he does the planting on time. The best time for planting is immediately after the rice crop is harvested. The land is then usually sufficiently moist to grow a fair crop of mungo.

The seed should be sown at the rate of about 50 liters per hectare, and the sowing done when there is just sufficient surface water on the ground to properly soak and sprout the mungo bean. A greater amount of surface water especially on heavy soils, will cause the seed to rot. After the seed is sown, a brush drag is run over the field so as to shake down to the ground all the seed which might otherwise have remained suspended in the rice straw.

If this method is followed, there will be sufficient growth of mungo to keep down the weeds and to yield enough beans to pay for the seed used and the work of planting and harvesting, plus an appreciable net profit.

The yield of beans is not the only benefit to be derived from this practice. Mungo is a leguminous crop, and, as such, it fertilizes the soil. For heavy lands the leguminous crop will not only add fertility to the soil, but it will also make the ground looser and easier to work. For extensive fields, therefore, the best systems to follow is to plant as large an area as practicable with mungo every year. If, for any reason, the entire area is not planted to mungo, care should be taken that in the following season the first planting should be on the land unplanted the first season, so that ultimately all sections of the land will have been grown to this crop.

If farmers would only realize the advantage of planting some of the legumes such as mungo after his rice each year he will be surprised at the improvement in the condition of his soil, the greater ease with which he can prepare the land for his rice crop and the added yield per hectare of his rice —all money making factors that our Filipino farmers should take advantage of, if they want to make more money in their farming operations.—PHILIPPINE FARMER, Vol. V, No. 9.

THE MARANG.

P. J. WESTER,

Agricultural Adviser.

The Philippine Islands have many native fruits; some of which are more or less edible and others that may be classed fair to good. The best of all is unquestionably the Marang, a tall, handsome tree, with large, dark green leaves, native to southern and western Mindanao and the Sulu Archipelago.

The fruit is as large as a child's head, roundish oblong in shape and has a soft, thick skin covered with brownish, soft spines. Inside of the skin and separating from it is the creamy white, sweet, rich, juicy, well flavored and

aromatic flesh, which separates into a large number of segments about the size of grapes, each one usually containing a seed, which again separates as readily from the flesh as a grape seed.

Several years ago fruits of the Marang were brought to Manila and many plants have been propagated and sent to the planters in Laguna, Tayabas, Cavite, the Bicol Provinces and others where the climate is suitable to the Marang, which requires abundant rainfall, evenly distributed throughout the year in order to do well. The trees are not recommended for districts with a long dry season, such as Manila, Rizal Batangas, Bulacan, Tarlac and Nueva Ecija.

Where the Marang succeeds well it is one of the best ornamental shade trees for planting along the roads and should be utilized whenever possible because of its valuable fruits.

The main fruiting season of the Marang extends from August to September and October, though there is sometimes a second crop in December and January.

The Marang is usually eaten raw as a dessert fruit, and is excellent when iced, but the delicious preserve made from the mangosteen in Jolo, by boiling the flesh and seeds in brown sugar, suggests that the marang could also be preserved in the same way, and with equally good results, as the seeds would undoubtedly provide for the marang preserve the same delicious nutty flavour which in the mangosteen preserve is imparted by the mangosteen seeds.—PHILIPPINE FARMER, Vol. V, No. 9.

COWPEA PRESERVATION.

Considerable difficulty is often experienced by local planters in keeping cowpeas and other beans for any length of time free from bean weevils, and during the past many lots of beans and peas kept in storerooms awaiting favourable weather for planting have been destroyed by these pests. It is fairly well-known that applications of carbon bisulphide will free grain from weevils, but there are several drawbacks to its being commonly used for this purpose. In the first place, carbon bisulphide is expensive, and in addition there is an element of danger always present when it is handled, on account of its being highly inflammable. Its obnoxious odour also renders it unpopular.

Two lots of cowpeas were put up in open bottles. One lot was stored in air-slaked lime at the rate of 4 parts of peas to 1-1½ parts of lime by weight, and one lot was stored without lime. The experiment was commenced in January and was carried on for six months. Cowpeas which were untreated were attacked by weevils in four weeks' time, and those put up with lime were quite free from weevil attacks in July, six months after storing. Germination tests were made in July, and the peas kept in lime gave 96 per cent. The untreated lot was badly damaged by weevils, and thrown away some considerable time before the experiment terminated.

From the above it will be seen that planters have a cheap and effective method of keeping cowpeas free from a pest which in the past has caused them a considerable amount of worry. Although cowpeas are specially mentioned in the above, it is possible that many other grains which are being kept for planting purposes can be preserved in a similar manner.—REPORT OF AGRIC. DEPT., ANTIGUA, 1917-18.

FIBRE.

THE CULTIVATION OF SISAL HEMP IN MYSORE.*

A. CHATTERTON, B. Sc.,

Director, Sandal-wood oil Factories, Mysore State.

In this note which is specially written for the people of Mysore, it is hardly necessary to point out that aloes of various species in most parts of the State grow luxuriantly and are largely planted to form hedges. From the leaves of these aloes fibre is extracted and used locally for the manufacture of ropes and twine. The fibre is not easy to extract as the leaves yield an acrid juice and the separation of the fibre from the pulp is a tedious operation. The industry, if it can be so called, is a purely domestic one carried on merely to supply local needs. There are machines which will easily extract the fibre ; but they are costly and require a large amount of power to drive them. They are hopelessly beyond the reach of the cultivators. Further, it is an unfortunate fact that, although aloes are extremely plentiful in Mysore, the species which have been introduced are those which yield but a small percentage of a weak fibre which has a comparatively small commercial value.

There is, however, one species of aloe, the botanical name of which is *Agave rigida* var. *Sisalana*, which is very largely cultivated for fibre in Yucatan, the Bahamas, Florida, what was formerly German East Africa and, to a very limited extent, in some parts of India. This aloe yields a very valuable fibre which is in great demand for the mnnufacture of binder twine, of which enormous quantities are employed in America every harvest. It was introduced into Mysore by the late MR. RICKETTS in 1892 and since then has been to some extent cultivated at the Lal-Bagh in Bangalore and from those gardens fairly large numbers of young plants have been supplied to various parts of India. So far as Mysore is concerned, nothing practical has resulted from the introduction of this plant ; but just outside the borders of the State in Coorg, a small plantation of sisal hemp has been worked successfully for the past five years.

In 1914, in Bulletin No. 18 published by the Industries and Commerce Committee of the Mysore Economic Conference, I drew attention to the commercial possibilities of sisal hemp in Mysore ; but so far no one has been induced to take up the cultivation of this species of aloe on a commercial scale. After an interval of four and half years, during which I have had opportunities of watching the growth of sisal hemp plants, I am still of opinion that its commercial possibilities in Mysore are very great ; but I have realised that nothing is likely to result from advocating the formation of planting companies to take up extensive areas of land with a view to the establishment of large plantations.

* Note submitted to Government of Mysore.

Before proceeding further, it will be necessary to give some brief account of the conditions under which sisal hemp will grow. MR. CAMERON, at that time the Curator of the Lal-Bagh, in a paper contributed to the Proceedings of the Agri-Horticultural Society, Madras, in 1903 wrote as follows : "In my opinion, cultivation should be left to private enterprise, though in the case of arid tracts where ragi often fails to reward the raiyat, it may be feasible to substitute a crop of this kind ; but that could only be done when a real demand for hemp arises at convenient centres. The advantages of cultivation may be briefly stated as follows :—

(1) Land of gravelly and stony nature is suitable ;

(2) When land is planted up, the cultivation practically ceases for a period of four years or until the matured leaves are ready for cutting ;

(3) On suitable land failure of crop has never been heard of ,

(4) The profit on an acre of land yielding crop is estimated at from Rs. 60 to Rs. 75 per annum.

"The large succulent growth obtained in rich land is inimical both to the quantity and quality of fibre produced ; therefore somewhat poor land of a loose stony nature is always preferred, as in addition to giving better results generally it accommodates a larger number of plants to the acre. Mysore possesses plenty of such land, and if the latter can produce leaves of four feet in length it will do ; but there is a reduction in value, as well as difficulty in extracting the fibre, when the leaves are under three feet in length."

From other authorities on the cultivation of sisal hemp, I have gathered information which may be briefly summarised as follows :—Sisal hemp will grow on arid land that seems incapable of any other vegetable life ; but the best fibre is grown on a calcareous gravelly soil of medium quality. No fertilizer is ever used. Once the plant has taken root in the ground, no further attention is necessary and the cost of cultivation is negligible. The fibre is, however, difficult to extract by hand but is easily got out by suitable machinery. It takes from five to six years for the plant to grow to the proper maturity to begin cutting leaves. When the plant is growing, all its leaves point upwards ; as the plants mature. the leaves begin to open ; as they open, they begin to fall towards a horizontal position. As soon as the leaf becomes horizontal, it is perfectly mature and must be promptly cut in order to secure from it the most fibre in the best condition. If properly cared for, a plant continues to yield leaves for about fourteen years in rocky soil and eight years in fertile soil ; but if the leaves which become horizontal are not properly cut, then the plant throws up a stalk instead of leaves and this is the death of the plant. If the cutting of the leaves be neglected, the plant throws up a stalk and when the stalk appears, there is great danger that all the plants in its vicinity will also send up the stalk and die. When the plant reaches the limit of its age, this stalk grows from the centre of the plant and the plant dies. Leaves weigh from 1 to 1½ pounds and 1,000 leaves will yield from 50 to 75 pounds of fibre.

On suitable land, bearing 1,000 plants to the acre, the yield of fibre may be reckoned at not less than one pound per plant per annum or 1,000 pounds per acre. The fibre was worth in London about £30 per ton before the war

and is likely to remain so owing to the increased cost of cultivation and difficulties which have arisen in two of the largest areas of production. These are Yucatan in Mexico and German East Africa.

It appears to me that the principal reasons why sisal hemp cultivation has not been taken up in Mysore although the plant grows readily enough and yields a high quality of fibre are as follows :—

(1) Six years must elapse before any return can be expected ;

(2) The extraction of the fibre by hand is not possible as a commercial proposition ;

(3) The extraction of the fibre by machinery necessitates operation on a large scale and the investment of a large capital on machinery and plant ;

(4) There is no local market for the fibre and small parcels do not command a fair price when exported.

Objections of a similar nature and of equal or greater intensity retarded the development of the cultivation of both tea and coffee and the establishment of the tea industry in India is largely due to efforts on the part of the Government of India at the outset. These industries are still mainly in the hands of European planters, though there is now, both in Assam in connection with the tea industry and in the South of India in connection with coffee, a marked tendency towards the development of Indian-owned plantations.

I have already referred to the plantation which has been started in Coorg and in course of time other sisal hemp estates may be opened out. There are, however, excellent reasons why the matter should not be left to chance. Moreover, it is desirable that the cultivation of sisal hemp should be so developed that the ordinary cultivators of the country should, as far as possible, participate in the benefits to be derived from it.

The Mysore Durbar obtains a not inconsiderable percentage of its revenue from mineral royalties and from the sale of electric energy which is still mainly used on the Gold Fields. Sooner or later, this source of revenue will be extinguished with the exhaustion of the Mines and it will be a wise policy, while there is yet time, to create new sources of revenue to take its place. The electric energy may be used for other purposes, provided industries are created which will employ the power. Satisfactory progress in this direction has already been made and there seems every prospect that, as electric energy becomes available, a market for it will be found in the growing industries of the State ; but the gold royalties will gradually decrease and ultimately disappear and it will be sound policy to look well ahead and endeavour to create new sources of revenue. In the last few years, the public attitude in respect to the intervention of the State in industrial matters has completely changed and there is no reason why the Mysore Durbar should not take active measures to create new industries if it is in a position to do so.

It appears to me then that an excellent opportunity to do something in this direction is presented by the failure of private enterprise to take advantage of the natural facilities which exist for the cultivation of the sisal

hemp plant. About one-half the area of the Mysore State is uncultivated and there are obviously tens of thousands of acres of waste land which could be well utilised for the cultivation of a plant which grows best on soils which are perhaps favourably described as being on the margin of cultivation.

If the raiyat were in full possession of the information contained in this note and further if he could be induced to accept it as approximately true, there is scarcely any doubt that, provided he was not asked to find capital which he does not possess, he would readily take to the cultivation of sisal hemp. The problem then to be solved is to convince the raiyat that it is worth his while to grow sisal hemp and this can only be done by removing the difficulties which have hitherto prevented the development of the cultivation. This can be done through the agency of the Economic Conference, the District Committees and the various associations which have been established to develop the material resources of the State. Village Committees have been formed in thousands and it is possible that village communal plantations could be started which would ultimately provide these local bodies with a revenue which could be usefully employed on the various schemes of village improvements which are under contemplation.

Government can assign land for the cultivation of sisal hemp free of kist for a period of say seven years, a sufficient time to enable the plants to be brought to maturity. It can supply the plants, charging only the actual cost, and deferring the payment till the raiyat begins to derive an income from them. It can also establish nurseries and model plantations in selected centres to demonstrate its faith in the future of sisal hemp in the Mysore State, and to afford ready means whereby the raiyats can obtain young plants and instructions how to cultivate them ; but it is necessary that Government should go a great deal further than this as individual raiyat will be unable to extract the fibre from his plants and, even if he did extract it by hand, he would be unable to obtain a fair market for it. Government must therefore be prepared to guarantee to take over the crop of leaves when they are mature and to provide the necessary machinery for extracting the fibre, also to undertake the marketing of the crop.

It is difficult to frame an accurate estimate of the returns to be obtained from the cultivation of sisal hemp, as I am not in a position to state what price the hemp will fetch five or six years hence and I can only make an assumption on this point. The price, in London, immediately before the war was from £28 to £30 a ton and it is almost certain that it will be considerably higher than this after the war. I think it will therefore be fair to assume that sisal hemp will realise three annas per pound or Rs. 420 per ton and as each plant will yield a pound of fibre and at 1,000 plants to the acre, the gross return will be Rs. 187-8-0 per acre. In 1914, MESSRS. KIRWAN & ELSEE stated that, as a result of their experience, the cost of extracting and marketing the fibre was about Rs. 175 per ton. It is likely that this figure will be exceeded in the future as freights will certainly be higher but the cost of working under Indian management should be lower. Allowing, however, a wide margin for contingencies, we may put the charges under this head at Rs. 280 a ton which will leave the raiyat Rs. 140, equivalent to one anna per plant per annum. With a thousand plants to the acre, the

raiyat may expect to obtain a net return of Rs. 62-8-0 per acre. It may easily be considerably more than this but it is hardly likely to be less.

It will serve no useful purpose to go into minute details as accurate data for them are not available. I think it is sufficient to show that sisal hemp cultivation offers prospects of an extremely good return. My estimate of the prospects is strongly supported by certain general considerations about which there is no doubt whatever and which do not depend upon assumptions regarding current market prices. We know that the sisal hemp plants will grow in Mysore in a perfectly satisfactory manner and will yield a high class of fibre comparable with the best fibre produced in other parts of the world. Further, we know that the conditions in Mysore are such that the cost of bringing the plants to maturity, of cutting the leaves, of extracting the fibre and of putting it on the market will be less than in any of the tracts where sisal hemp is now cultivated. It is therefore quite certain that, if sisal hemp is grown in Mysore on a sufficiently large scale, it will be able to compete with plantations in other parts of the world.

I have no accurate figures regarding the total production of sisal hemp ; but it is estimated that the world's consumption of binder twine alone is 250,000 tons per annum. India exports large quantities of hemp, chiefly sunn hemp, a fibre inferior to sisal hemp and commanding a much smaller price, and the following figures extracted from the Sea-borne Trade Returns are of interest as showing how important the Indian fibre crops are:—

Year	Exports in tons	Value in Rupees	Value per ton at port of shipment
1914-15	33,511	Rs. 99,43,334	Rs. 298
1915-16	30,413	,, 1,02,53,742	,, 337
1916-17	35,059	,, 1,52,26,058	,, 338
1917-18	16,886	,, 88,29,696	,, 528

The great reduction in exports in 1917-18 is due to the restrictions on shipping as the very high price realised clearly indicates a strong demand.

It is now necessary to indicate briefly the commitments of Government if these proposals are accepted for the encouragement of the cultivation of sisal hemp. For a period of at least ten years, Government will have to establish nurseries in many parts of the State and to maintain them for demonstration and for instructional purposes. An average of a lakh of rupees a year will not be too much to spend on this account. For the first six years, there will be no return; but after the expiry of this period, the raiyats should commence the repayment of the cost of the plants supplied to them. At the end of four years, it will be necessary to purchase machines for extracting fibre and to set up central depots for the receipt of leaves, where the fibre will be extracted. We may take it that each central depot will cost at least Rs. 60,000 and that will be capable of dealing with 500 tons of clean fibre per annum, equivalent to the produce of 1,120 acres. This is the most economic unit that can be employed for extracting fibre; but in places where so large an area is not brought under cultivation, smaller

machines capable of dealing with only 200 or 300 acres can be employed at the outset. There can scarcely be any doubt that once this cultivation is started on the lines herein set forth and once the profits are realised it will spread very rapidly and will probably extend to hundreds of thousands of acres. Roughly, each thousand acres will require an outlay of Rs. 60,000 in machinery and plant and that each thousand acres will yield nearly two lakhs of rupees worth of fibre. Obviously, the more extended the scale of cultivation the greater will be the return realised.

It would be comparatively easy to produce definite figures based on certain assumptions; but this I prefer not to do and to leave the result stated in a somewhat vague form. I have no doubt that if this matter is taken up in a thoroughly efficient manner and carried on strenuously, it will result in at least a lakh of acres being brought under cultivation within a reasonable period and from this area, gross returns of from Rs. 1,75,00,000 to 2,00,00,000 will be obtained. Such a result is well worth investing a lakh of rupees per annum for a certain number of years. The capital expenditure necessary after the cultivation is established, requires no justification. There is not the least doubt that it will yield a very handsome return. To deal with a hundred thousand acres will require about 5,000 Horse Power and in many parts of the State this power will be available in the form of electric energy and where such is the case the working expenses will be greatly reduced.

So far, I have only considered the question from the point of view of producing a crop which can be exported; but there is no reason whatever why the raw material should not be worked up into finished goods in this country. With electric power available, factories for the manufacture of ropes and twine can be established and worked as cheaply as anywhere in the world. It is not necessary now to consider this in detail. With large supplies of raw material at hand, there is no doubt that private enterprise will, in due course, be forthcoming.—MYSORE ECONOMIC JOURNAL, Vol. V. No. 4.

TREATMENT OF COTTON SEED BEFORE SOWING.

The Manager of the State Farm, Roma, has forwarded a sample of cotton seed to the Agricultural Department, which seed has been specially prepared to admit of sowing by means of a seed-drill. In commenting on the matter, the Director of Agriculture states that the fluffy fibre adhering to the Upland cotton seed after "ginning" and "linting" causes the seeds to bunch together, which means that the sowing has to be done by hand, which is a tedious process. This latter difficulty has now been overcome by treating the seed with fine puddled clay, which envelops the loose fibres and leaves the seed in a smooth rounded form, in which condition, after drying it will readily pass through the drill—a process calculated to reduce the cost of planting operations.—QUEENSLAND AGRIC. JOURNAL, Vol. XII, October, 19.

OILS.

COMMERCIAL POSSIBILITIES OF PARA RUBBER SEED OIL.

B. J. EATON.

Since the publication in the *Agricultural Bulletin, F. M. S.*, Vol. VI. No. 5, February, 1918, of the results of the investigations carried out at the Agricultural Department which has attracted considerable attention outside Malaya, a detailed report has been received from MESSRS. ROSE, DOWNS & THOMPSON, the well-known oil machinery manufacturers of Hull, on a consigment of about 26 tons of undecorticated rubber seed despatched by the Director of Agriculture. The information contained in this report together with observations made by the Director of the Imperial Institute are embodied in the present article.

The seeds composing this consignment were collected from several estates in Selangor, the cost of collection varying on the different estates. The consignment consisted of three different lots of 87, 162 and 204 bags, respectively, or a total of 453 bags which weighed on receipt in Hull 25¾ tons.

The following are the details of the cost of the seed and total value of the oil and meal as supplied by MESSRS. ROSE, DOWNS & THOMPSON :

	Tons.	cwt.	qrs.	lb.	per cent.
Weight of seed treated	25	15	1	7	
,, oil from whole seed by extraction	4	19	1	26 =	19·30
,, foots	0	15	1	2 =	2·93
,, meal	19	4	2	0 =	76·60
Loss in working	0	6	0	7 =	1·17

ACCOUNT SALES.

	£	s.	d.
(Oil 5 tons, approx.)	286	17	6
Meal (19¾ ,, ,,)	157	16	0
Total ...	£ 444	13	6

Oil ... £50 per ton. Meal ... £8 per ton.

COSTS.

	£	s.	d.
Less disbursement and expenses, London charges, customs, entry port dues, landing and wharfage charges	19	18	4
Carriage, London to Hull, and local transport, Hull	26	13	11
Analyst's fees	5	5	0
Total ...	£ 51	17	3
Net proceeds	£ 392	16	3

From the above sum, the cost of the seed, freight charges on rail in the Federated Malay States and from Port Swettenham to London and cost of extraction of the oil have to be deducted.

No information was supplied as to the cost of extraction of the oil, but the remaining figures of cost are as follows:

Cost of collection of seed ...	$ 450 = £ 50, approx.	
Freight charges and handling, Kuala Lumpur *via* Port Swettenham to London	$ 3415 = £ 400	,,

From the above figures it will be seen that the cost of freight on the seed was not covered by the amounts realized by the sale of the oil and meal, after deducting costs in England.

The freight charges, etc., on the three consignments, which were shipped on separate dates, varied from $ 6·83 to $ 9·37 per bag.

It is scarcely necessary to add that the freight charges are very high, owing to the abnormal conditions in 1916 and 1917 and that it would not be desirable from an economic standpoint, even in normal times, to ship seeds, husked or unhusked, from this country.

Method of extraction.—The whole seed was extracted by MESSRS. WRAY, SANDERSON & CO., LTD., seed-crushers of Hull, in chemical extraction plant. It was unfortunate that the seeds could not be decorticated first and also that they had to be extracted, on account of conditions, by chemical solvent extraction instead of by hydraulic pressure mills.

The treatment of undecorticated seed involves the handling of nearly double the weight of material, since the seeds consist of about 40 per cent. of shell containing no soil; secondly, meal or cake from undecorticated seed, containing a large proportion of the hard shell, would be of very low value for feeding purposes for cattle or sheep; thirdly, extraction by chemical solvents, although it removes practically all the oil, probably renders the residual meal unfit for cattle feeding, on account of both its flavour and low percentage of oil. The method of extraction, however, shows the maximum oil-content of the whole seed obtainable under average commercial conditions, which compares favourably with analyses made in the laboratory.

It should be mentioned also that the price obtained for the oil, viz., £50 per ton (approx.) is an enhanced price, due to present conditions, and compares with £60 per ton, which was the price of linseed oil at the time.

Under pre-war conditions, linseed oil fetched about £30 per ton and Para rubber seed oil would probably fetch £20 to £25 per ton.

REPORT ON THE OIL.

Apart from the criterion of the value of the oil, as indicated by the price realized, a sample was submitted also to a firm of paint manufacturers, who reported that the oil might be used to some extent as a substitute for linseed oil but that it was more probable that it would only be used to mix with other oils, i.e., in the nature of an adulterant. The oil, as was known previously, is not equal in quality to linseed oil as a paint oil or for varnishes. This firm valued the oil for its own purpose at £20 per ton in normal times, compared with £30 per ton for linseed oil. It may, on the other hand, prove more useful than linseed oil, which is said often to dry too quickly in hot climates, but this remains to be proved by actual experience.

The oil would probably not have any special value for other purposes, since for soap-making, etc., other fats and oils are available.

Results of analyses.—The analytical results obtained on the sample were as follows. (The figures for linseed oil and for previous samples of rubber seed oil are given for comparison).

	Rubber seed oil. (Present sample)	Rubber seed oil. (Previous sample)	Linseed oil
Specific gravity at 15·5C°...	0·9245	0·925	0·932—0·937
Jean's refractive index at 22°C	+ 24	...	...
Zeiss ,, ,, 40°C	+ 62	...	72·74
,, ,, ,, 25°C	+ 75	...	...
Wij's iodine value	139·3	128·5—143·3	175—200
Saponification value	192·5	188·5—192·1	186—194
Free fatty acids (as oleic acid) (per cent.)	16·9	5·3—20·5	0·0—5·0
Drying test	Poor		Good

The high acid value of the oil from the present consignment of seed is probably due to deterioration during transport.

The oil was also dark in colour, due probably to colouring matter extracted by the solvent from the shell. The remarks on the unsatisfactory character of the oil from this consignment of seed for paints and varnishes are no doubt due largely to its high content of free fatty acids, since when mixed with white lead it would produce a pasty paint, which would not spread well.

RUBBER SEED MEAL OR CAKE.

The residue from the extraction by solvents may be described as a meal rather than an oil cake and was stated to have been sold for the purpose of mixing as an ingredient of a compound feeding cake.

The analysis of the meal gave the following results :

	Per cent.	
Moisture	8·24	
Oil	4·48	
Proteins	17·50	(containing 2·8 per cent nitrogen)
Carbohydrates	32·29	
Woody fibre	34·86	
Mineral ash	2·63	(silica 0·25 per cent)
Food unit value ...	87·24	

The large percentage of woody fibre is accounted for by the husk or shell and detracts considerably from the value of the product as a feeding material. It was not, however, possible to carry out any feeding experiments, under the conditions prevailing.

The following is an analysis of meal from the kernel only, with the oil reduced to about the same figure :

	Per cent.
Moisture	12·50
Oil	4·00
Proteins	33·25
Carbohydrates	39·75
Woody fibre	4·20
Mineral ash	6·30
Food unit value	132·87

The low woody fibre content of the above meal compared with that of meal from the undecorticated seed may be noted.

The following calculated analyses for oil cakes from undecorticated and decorticated seeds, obtained by expressing the seed in hydraulic presses, are of interest. The oil-content of the cake from the decorticated seed is assumed to be 13 per cent. but a smaller quantity of oil would remain in the cakes by twice pressing. For comparison, previous actual analyses are given, together with an analysis of linseed cake :

	(1) Cake from undecorticated seed.	(2) Cake from decorticated seed.	Previous analysis	Linseed cake.
	Per cent.	Per cent.	Per cent.	Per cent.
Moisture ...	12·00	11·00	8·75	11·6
Oil	8·00	13·00	8·71	9·50
Proteins ...	18·37	33·25	30·19	29·5
Carbohydrates ...	24·93	32·25	41·71	35·54
Woody fibre ...	32·00	4·20	5·01	9·10
Mineral ash ...	4·70	6·30	5·60	5·20
Food unit value	90·85	147·87	139·00	133·00

VALUE OF EXTRACTED MEAL AS A FERTILIZER.

MESSRS. ROSE, DOWNS & THOMPSON have also had the meal examined from the point of view of its use as an artificial fertilizer.

The figures obtained are as follows :

	Per cent.
Nitrogen ...	2·80 (= Ammonia 3·00 per cent)
Phosphate of potash	1·00

At the Government rates ruling at the time—viz., 17/6 per unit, the product was worth £2 12*s.* 6*d.* per ton, which is very low and much less than its valuation as a feeding material.

GENERAL CONCLUSIONS.

MESSRS. ROSE, DOWNS & THOMPSON point out that by chemical solvent extraction there would be no difficulty in reducing the oil-content of the residual meal, if desirable, to 1·5—2 per cent.

If the seed were expressed in hydraulic mills, they state that there would be no advantage in cold pressing first, in order to obtain a paler oil, followed by hot pressing to get the maximum amount of oil. Two pressings of heated seed, if necessary and economical, would be preferable.

In the consignment sent, the whole seed contained about 45 per cent. of shell to 55 per cent. of kernel. If the shell were removed before expression it could be used as fuel or possibly as a manure, although its value is not great for this purpose.

MESSRS. ROSE, DOWNS & THOMPSON also point out, with regard to the problem of machinery for expressing oil, that it would not be economical to run a plant for say about three months in each year and also that it is desirable to run such plant day and night, and not during the day only, stopping say at week-ends only. The writer has continually emphasized this point in discussing the running of oil machinery in this country.

Further, it is not desirable to use such plants for more than one kind of oil seed, as better results can be obtained by working continually on one type of seed. This means that the problem of storing seed should be considered, with the object of keeping the plant running throughout as long a period during each year as possible.

Decortication of the seed, prior to expression, is recommended, as has been recommended by the writer in this country, primarily on account of the fact that the shells contain no oil, and since they constitute over 40 per cent. of the seed, nearly double the quantity of decorticated seed can be treated in any given period. Further, the residual cake is of more value as a feeding material.

MACHINERY.

The following details with regard to machinery required are of interest.

Hydraulic plant:—Capacity 1·34 tons of undecorticated seed per hour or 1 ton of decorticated seed per hour equivalent to 7,200 tons of decorticated seed per year of 300 days of 24 hours per day. Plant supplied to decorticate the seed and press twice, working continuously.

The plant includes:—

(1) Two decorticators;
(2) One set of crushing rolls of 5 rolls, 4 feet long by 16 ins. diameter;
(3) Two hydraulic "Premier" (i.e., cage) presses, each with kettle;
(4) One cake breaker;
(5) One set Anglo-American rolls for re-grinding cake from cake breaker;
(6) One Kettle for Anglo-American presses;
(7) One cake-moulding machine
(8) Four Anglo-American (i.e. open) presses;
(9) One set edge-stones;
(10) Cake-paring machine

Necessary pumps; elevators, conveyers, tanks, accumulators, pipes and fittings, press mats and cloths and driving gear, exclusive of belts. Engine and boiler not included.

Pre-war price (excluding freight by sea)	£5,780 0 0
Estimated present cost ...	11,560 0 0

Chemical extraction plant.—Capacity 2¼ tons of undecorticated seed or 1¼ tons of decorticated seed per hour of 9,000 tons of decorticated seed per year of 300 days of 24 hours per day.

(1) Decorticating Machinery.
(2) Reducing and grinding plant.
(3) Extraction plant-standard unit of four extractors.
(4) Meal-drying, cooling and bagging plant.

All necessary conveyers, elevators, connecting pipes and fittings and driving gear, except belts. Excluding boiler and engine.

Pre-war price	£5,900 0 0
Estimated present cost ...	11,800 0 0

QUANTITY OF SEED AND OIL FROM ESTATES IN MALAYA.

The area under rubber cultivation in Malaya is, approximately, 1½ million acres, of which 1 million may be taken as European-owned or managed estates.

The yield of seed may be taken at about 400 per tree and assuming 90 trees per acre, the yield per acre would amount to 306 lb. (1,000 seeds = 8·5 lb.)

This gives a total yield of 130,000 tons of seed per annum, which, on a 20 per cent. oil basis, represents 26,000 tons of oil.

From an economic point of view it would be preferable to express or extract decorticated seed. The quantity of decorticated seed, on the basis of 55 per cent. kernel, would amount to 71,500 tons, which could be taken as yielding by expression 36 per cent. of oil or as above 26,000 tons, approximately.—AGRIC BULLETIN OF THE F.M.S.—Vol. VII., No. 2.

PALM-OIL AND KERNELS.

The quantity of palm-oil and palm kernels annually exported from the Gold Coast from 1912 to 1917 is as follows:—

EXPORTS OF PALM-OIL AND KERNELS.

Year	Oil gallons	Kernels Tons
1912 ...	1,444,432 ...	14,628
1913 ...	860,155 ...	9,744
1914 ...	495,763 ...	5,633
1915 ...	330,990 ...	4,064
1916 ...	450,360 ...	5,857
1917 ...	198,900 ...	4,768

"These figures illustrate the steady decline of the palm industry in the Gold Coast, which has synchronised with the growth of the cocoa industry, and which even the depressed prices locally ruling for the latter product have failed to revive. The far less exacting labour which the cultivation of cocoa, as generally carried on in the Gold Coast, entails upon the farmer, disinclines him to return to the much harder work of preparing kernels and palm-oil for the market. The money won from cocoa during the past ten years, moreover, is probably not yet exhausted; and it cannot be hoped, I think, that the palm industry will revive, save possibly under the stress of really acute financial embarrassment. At the present time, though special shipping facilities are accorded to exporters of palm-oil and kernels, which products are in great demand for the manufacture of Munitions and for other purposes in the United Kingdom, the prices locally ruling do not greatly tempt the natives to engage once more in an industry which they of late years have very generally abandoned."

"Much discussion has recently taken place as to the best oil and kernel producing varieties of the West African palm-trees, the effects produced by cross-fertilisation and other similar questions; and it has been suggested that good results might be obtained by the adoption of what practically amount to plantation methods of the modern European type. So far as the Gold Coast is concerned, and having regard to the high cost of labour in this Colony, I cannot think that any such experiment is likely to prove financially profitable."

"During the past few years two British companies, which have established themselves in the Western Province, have erected expensive and up-to-date machinery for the treatment of palm-oil and kernels, and have laid down systems of tram-lines designed to keep the factories fully and regularly supplied with the necessary material. I have not had an opportunity of personally visiting either of these works, but I am informed that the operations of both companies promise to yield good results. Though, as I have said, I cannot think that the cultivation of palms in plantations under European management is likely to prove a profitable enterprise, there is obviously considerable scope for improved methods of treatment, production, transportation and even of cultivation on the lines now being followed in the Western Province.—BULLETIN OF THE IMPERIAL INSTITUTE, Vol. XVII, No. 1.

SHIPPING COCONUT OIL IN BULK.

"With reference to the difficulty connected with the shipping of coconut oil in bulk in tank steamers," writes MR. B. J. EATON in the Straits *Bulletin*, which is due to the solidification of the oil in cooler climates, the recommendation contained in the paper entitled 'Copra and Coconut Products,' published in the AGRICULTURAL BULLETIN Vol. VI., No. 12, November and December, 1918, shows how this difficulty could be easily overcome by the use of steam coils in or around the tanks." Following this comes the information received from MESSRS. HARPER & Co., Kuala Lumpur, on behalf of the Asiatic Petroleum Company, which should be of interest. The letter states :—

"It will be of interest to your Department to learn that regular shipments of coconut oil in bulk have been made from Java to the Pacific Coast of America in the double bottoms of cargo steamers. As stated in the article in the AGRICULTURAL BULLETIN, the difficulty of solidification in winter can easily be overcome by fitting steam coils, the installation of which, in double bottoms, presents no difficulty."

One of the greatest difficulties in connection with export of the oil is therefore easily overcome.

This method of overcoming the difficulty was pointed out in the TROPICAL LIFE as long ago as June, 1914 (p. 112,) after we had discussed the problem fully with the head of a leading West Indian shipping firm, used to handling not only vegetable oils, but also pitch in all degrees of hardness or softness.

"What the shipper has to remember," we pointed out, "is that vegetable oils, which in the Tropics remain liquid, and can easily be pumped into the tanks, become denser and more solid as they approach the temperate zone, until, when the time comes to unload the cargo, it is no longer liquid but solid, especially if, as can quite well happen, a temperature below freezing-point prevails at the unloading port at the time of the vessel's arrival. To overcome this—which, we take it, would be no trouble but an advantage on the voyage, since a solid cargo is less dangerous than a liquid one to carry—steam coils should be, and properly would be, introduced into the ship's tanks, and by means of these the oil would be heated and liquefied sufficiently to be pumped out. As to what heat would be necessary, must depend entirely on the length of piping through which the oil has to pass and the temperature outside, for if the thermometer was below freezing-point, then the oil would require to be sufficiently warmed to keep it liquid until it reached the storage tank ashore, or the transport receptacle waiting to move it inland. We leave it to experts to say the temperature required. It would have to be about 90°F., and if carefully purified oil, as for human consumption, is being handled, it might even go as high as 280 to 300°F., we believe, without fear of harming the oil ; but as a rule 120 to 150°F., should be sufficient, unless the piping extends a considerable distance, and the weather was unusually cold."

As things tend to drift to-day, the shipment of coconut and other vegetable oils in bulk must be taken into account as likely to be necessary. If its movement through piping of a considerable length proved necessary, this could be arranged if here and there it ran through a heated chamber where any idea of becoming thick and solid would be at once prevented.—

TROPICAL LIFE, Vol. XV, No. 9.

CEYLON AGRICULTURE.

COMMITTEE OF AGRICULTURAL EXPERIMENTS.

Minutes of a Meeting of the Committee of Agricultural Experiments held on Thursday, November 13th, 1919, at 2-30 p.m.

Present :—The Acting Director of Agriculture (Chairman), the Government Entomologist, the Acting Government Chemist, the Acting Mycologist and Botanist, the Chairman Planters' Association, the Chairman Low-Country Products Association, Hon'ble Mr. Græme Sinclair, Messrs. G. H. Masefield, M. L. Wilkins, J. B. Coles, Neill Campbell, D. S. Cameron, E. W. Keith, L. A. Wright, A. W. Beven, C. E. G. Pandittasekera, Mudaliyar A. E. de S. Rajapakse and G. Harbord (Secretary).

Visitors :—F. P. Jepson, Asst. Entomologist, Messrs. J. Horsfall and C. W. Wood.

With reference to the minutes of the previous meeting, the Chairman proposed to delete the sentence "it was possible that there was more than one species of Phytophthora" which did not represent our present knowledge. He stated that, in Ceylon, it was already known that one species of Phytophthora occurred on Tobacco, another on yams (Colocasia), two on Hevea, one on Cacao, and one on coconut. The species on cacao was identical with one of those on Hevea, and probably with that on coconuts. The deletion was agreed to.

In response to queries as to the effect of the two different species of Phytopthora on Hevea, the Chairman stated that one of them, Phytophthora Faberi, caused leaf fall, fruit disease and Claret coloured Canker, while the other, Phytophthora Meadii, caused leaf fall, fruit disease and one form of Black Thread. One of the chief differences between the two lay on the general effect of the fungus on the tree. During the leaf fall caused by Phytophthora Faberi, little, if any, effect on the flow of latex was observable, but during the leaf fall caused by Phytophthora Meadii, the flow of latex was considerably diminished, and it might be so small that it was scarcely worth while to tap.

The Chairman announced that Government had written desiring that provision for an Asst. Mycologist should be made in the proposals for Estimates of the Department of Agriculture for 1920-21. MR. L. A. WRIGHT enquired whether the Mycologist would be detailed specially for coconuts. The Chairman replied that it was generally inadvisable to detail officers for special crops, except in countries where separate experiment stations were maintained for each crop. If the Mycologist took up the study of Phytophthora, he would have to deal with it on Coconuts, Rubber, and Cacao.

The minutes were then confirmed.

The Chairman announced that MR. D. S. CAMERON was present to-day for the first time as a member of this Committee, and that they had also to

welcome MR. BRYCE, Asst. Botanist and Mycologist on his return from War Service.

The Chairman stated that SIR SOLOMON DIAS BANDARANAIKE had sent in his resignation as he had proceeded to Europe on leave.

The following gentlemen notified their inability to attend the meeting :— The Hon'ble the Govt. Agent, C. P., the Asst. Government Agent, Puttalam and MR. J. S. PATTERSON.

The Progress Reports of the Experiment Station, Peradeniya and Dry Zone Experiment Station, Anuradhapura were reviewed by the Chairman.

He mentioned that in accordance with the latest scheme the whole of the tea plots had been pruned in October. The identity of light leaf Manipuri was queried by members of the Committee and the Chairman promised to enquire into the matter. In response to query whether it would be possible to procure seed paddy from the Department, the Chairman replied that it was not possible to supply seed paddy at present, but that a seed farm would have to be started ultimately after the Economic Botanist had made some progress with his investigations in paddy.

AGENDA.

1. *Board of Agriculture.* The Chairman read the paper by the Director which had been circulated, with reference to the proposals of the Agricultural Society in regard to the Board of Agriculture. The proposals were approved by the Committee. MR. WILKINS said that it was very important that the dates of the Board of Agriculture Meetings should be fixed so as to coincide with Planters' Association meetings ; and asked when the re-organisation would take effect.

The Chairman replied that it was hoped to bring it into force in 1920.

2. *Shot-hole Borer regulations.* The Chairman read extracts from a memorandum by the Director which had also been circulated, proposing an amendment to the Shot-hole borer regulations which would permit the transmission of diseased specimens of tea to the laboratories at Peradeniya for scientific investigation. MR. MASEFIELD pointed out that under the regulations, tea seed could not be removed from infested estates, and asked whether the prohibition was intended to apply to tea seed. MR. JEPSON informed the meeting that recorded cases of the occurrence of shot-hole borer in tea seed were so few that they were negligible, and the Chairman stated that the regulations were not intended to apply to tea seed or tea leaf for manufacture. It was decided to amend the regulation to make these points clear.

MR. HORSFALL enquired whether unaffected estates within an infected area would come under this regulation. In reply the Chairman pointed out that area in this case signified estate, and not a district: consequently uninfected estates would not come under the prohibition.

3. *The coconut caterpillar.* MR. BEVEN wished to know what steps had been taken in the investigation of this pest.

DR. HUDSON gave a detailed account of the observations, which he had made, relating to the life history of the moth and also suggested some measures for controlling the pest.

He exhibited specimens of the moth in all its stages and also of a parasite wasp which was instrumental in checking the spread of the pest. He was inclined to think that the reduction in yield attributed to the damage done by this caterpillar is often due to other insects as well, such as the Coconut beetles, and that plantations which were kept well cultivated and manured would not suffer to any great extent from this pest.

4. *The fertilisation of the Coconut Palm.* MUDALIYAR RAJAPAKSE asked whether it was correct that the female flower of the coconut could not be fertilised by pollen from the male flowers of the same inflorescence. The Chairman stated that was so because all the male flowers dropped some days before the female flowers were open. MUDALIYAR RAJAPAKSE then stated that he had a case of a young coconut plantation in which the first palm which came into flower bore two inflorescences, both of which were developing nuts, and how fertilization had taken place was inexplicable to him as the plantation was an isolated one—the nearest clump of bearing palms being situate fully two miles away with a belt of jungle intervening.

The Chairman replied that the fertilization had no doubt been brought about by bees—they were known to travel to a distance of 4 miles in search of food.

5. *Re-arrangement of the Coconut plots. Experiment Station, Peradeniya.* The Chairman explained that it was really a matter of internal re-adjustment, the plots being re-arranged to secure better drainage.

MR. MASEFIELD suggested that as this district was not a particularly good one for coconuts and that as the Director had stated that it was doubtful whether results of material value to the Coconut industry would be assured on the Experiment Station, it was inadvisable to have a Coconut Experiment at Peradeniya. The area, 11 acres, might well be utilised for tea or rubber experiments.

The Chairman replied that some results might be obtained from manurial experiments, and botanical investigations: in any case the question of abolition would have to stand over until the Director's return from leave.

It was decided that the inspection of the Tea plots and new paddy fields had to be postponed until a more favorable opportunity.

The Acting Botanist and Mycologist exhibited a sample of the latest synthetic rubber which he had obtained in Germany, while with the Army of Occupation.

The meeting then terminated.

Sgd. G. HARBORD,
Secretary,
Committee of Agricultural Experiments.

Peradeniya,
19th November, 1919.

PROGRESS REPORT OF THE EXPERIMENT STATIONS.

PERADENIYA.

(From September 1st to October 1919).

Yield for the month of September was 2,461 lb. green leaf from 11 acres, and that for October 2382 lb. Made tea for July and August fetched an average of 53 cents for all grades.

Pruning.—This was started on October 1st and the whole area (11 acres) was completed by October 31st—one live branch being left on the bushes in the Manipuri Plots.

The method adopted was upon clean wood with short cuts, the prunings being heaped up alternate lines without forking.

All the plots, notably plots 141 and 144 (Assam Hybrid) are affected with Shot-hole Borer, but comparatively lightly, for instance in the case of the Assam Indigenous cattle manured plot, it estimated that quite 45% of the bushes were affected though mostly only to the extent of a single branch.

The rows of divisions marking division of the plots have been lopped.

An examination of the $2\frac{3}{4}$ acres new clearing of light leaf Manipuri showed 7% vacancies—these are being supplied with stumps from the nursery reserve.

The $4\frac{1}{2}$ acres new clearing of Dark leaf Manipuri show 10% vacancies: there being no reserve of stumps, and stumps being unobtainable in the district, the area will be supplied during the South-west monsoon from supply baskets. Seed has been obtained for this purpose.

Shade in the 2-acre block of young Huldubari Dooars having become excessive, alternate dadaps in every row have been heavily lopped.

COFFEE.

The present crop which promises to be a good one is coming in very slowly.

During October, it was only possible to supply 25 lb. Robusta and 30 lb. Hybrid against a large number of bookings.

In addition to the above-named, the Uganda and Quilon are bearing heavy crops.

The removal of suckers is being done where necessary.

CACAO.

Over a further area of 15 acres, the dadaps shade has been lopped so as to reproduce spreading shade at a height just clear of the cacao—some thinning out of dadaps has also been done.

A lot more of this work needs doing but labour is not available for the work at present.

The removal of suckers has been continued.

Two rounds of picking has taken place and a good crop is being gathered.

An excessive amount of damage has been done by squirrels which are on the increase—they are being dealt with.

A further consignment of $4\frac{1}{2}$ cwt. of cacao was despatched to Colombo and realised Rs. 80·00 per cwt.

COCONUTS.

The whole of the 10-acre plot (less 2 acres) which was overgrown with cheddy, has been cleared, ploughed and disc-harrowed.

The drains have also been opened out.

There is a high percentage of vacancies.

RUBBER.

The cover crop of Tephrosia Candida and Leucæna Glauca on Plot 140 B of six year old rubber has been eradicated.

There has been a round of weeding in all the plantations.

PADDY.

The preparation of the new area (2 acres) below the Meteorological Station for paddy continues—the irrigation channels and drains have been cut.

Nurseries were sown with the following varieties:—

1. Molagu Samba
2. Muttu Samba
3. Dr. Lock's Hatiel
4. Village Hatiel
5. Philippine
6. Elvi

on October 6th.

2 acres of Heenati in the old paddy field was harvested during the first week in October, in fair condition owing to the prevailing wet weather.

The yield was 25 bushels per acre.

Seed of 324 varieties of paddy from the various provinces have been received.

Each variety was examined, prepared and sown in a separate seed bed in the old paddy field.

Each of the 324 varieties will in due course be transplanted into separate strips in duplicate—and the whole collection will be at the disposal of the Economic Botanist on his arrival.

The 6 acres of Elvi (Hill paddy) growing on the new Economic plots has been weeded. It looks promising at present.

FOOD PRODUCTS.

Cassava—a considerable weight of yams has been secured and the balance of over-matured yams has been sliced and dried for flour.

FRUIT PLOTS

The Citrus and Custard Apple plots were found to be attacked with Pink disease to a considerable extent.

All affected branches were removed and burnt.

RAINFALL.

		Inches.	Wet days.
September	...	13·31	18
October	...	8·65	17

G. HARBORD,
Manager, Experiment Station.

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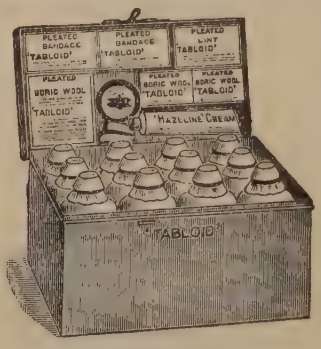

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ANURADHAPURA.

(From 1st September, to 31st October, 1919.)

The Director of Agriculture accompanied by the HON. MR. BALASINGHAM inspected the station on the 15th of October.

PADDY.

Very encouraging results were obtained from the yala crop of Elvi, 4 acres yielding 185½ bushels of clean paddy. This is reported to be a hardy variety producing a long grain which is in great favour with villagers.

100 bushels of seed paddy have been issued to the Asst. Government Agent, Kalutara, and a further 40 bushels have been reserved for the Government Agent, Uva.

"Time of sowing" Experiments.—¼ bushel of Macan Pina Manilla seed was sown in a nursery and the seedlings transplanted a month later, singly, 6 inches apart, on to 4 plots 1/5 of an acre each.

A nursery of Muttu Samba paddy has been sown for the next 4 plots.

Variety tests and botanical examinations.—Small plots of 105 varieties of 6-7 months paddies and 272 varieties of 4-5 months paddies collected from all the provinces in the Island have been put out in nurseries to be transplanted 4-6 weeks later in definite labelled blocks.

The plots have all been ploughed deep and left for a month to weather.

FIBRES.

The Mauritius fibre plot is being supplied. The portion not planted by the Archæological Reserve is also being planted out.

The interplanted Dhall plants have all been uprooted and replaced with Leucæna Glauca.

Arrangements have been made to get a further supply of Sisal hemp plants from Mahailuppalama to plant up the remaining portion and supply the few vacancies.

LIMES.

Steps have been taken to procure plants for planting out this plot no sooner the heavy rains have abated.

COCONUTS.

The unirrigable coconut area is being ploughed for planting a row of manioc down the centre of the rows.

The cheddy growth in the irrigable plot has been cut down and the land ploughed and disc-harrowed.

CASTOR.

The plants are still seeding freely. The dry seed is being collected and sent to Peradeniya.

FOOD PRODUCTS & CURRY STUFFS.

Green gram, dhall, and chillies have been harvested. 2 bushels of green gram have been supplied to the Teldeniya Tobacco Trial Ground.

Plots of mé, dhall, arrowroot and sweet potatos have been planted out.

The raisin variety of sweet potato has been lifted. 1/10th of an acre yielded a crop of 665 lb. of large yams.

The vines were grown on high ridges 2 feet apart, along the centre of the ridges. Cuttings about 12 inches long were planted a few inches apart.

The following varieties of Sorghum received from California have been harvested:—Dwarf Millo, Brown Corree, Shallu, and early Cumber. Select Millo and Dwarf Millo, the two close-headed varieties did best yielding 25 and 22½ bushels of grain per acre respectively. Seed of the best heads were carefully collected for resowing.

Moringa pterygosperma (drum sticks). A plot has been planted with stumps of the thick Jaffna variety kindly supplied by the Maniagar of Jaffna.

COFFEE.

The Robusta coffee plot has been topped and pruned. The Gliricidia and Dadap shade over the coffee have been thinned.

FRUIT SECTION.

The miscellaneous mango plot has been continued through to the Railway boundary.

The pine-apple plot has been continued through to the quarry near Railway.

The citrus trees were given a light pruning.

Two plots of papaw have been established.

The plantain plot has received attention. Suckers have been removed, leaving two to every parent plant. The intersown legumes have been pulled up and dug in round the trees and the plot resown with cow-peas.

Melons fruited freely and had a ready sale.

SUGAR-CANE.

Plots 85 and 86 which were in pines have been planted with sugar-canes from Peradeniya.

New plots 87 and 88 have also been planted with sugar-canes making one long strip of canes extending from the main road to the Railway line.

MISCELLANEOUS.

A new water channel has been made to irrigate the paddy land.

The site for the store has been levelled and the work of erecting the store is in progress.

Labour.—A gang of Sinhalese coolies have been obtained from the Matale district.

Several visitors have been personally conducted round by the Manager.

Weather conditions.—Violent and continuous showers are experienced every evening.

H. A. DEUTROM,
Manager, D. Z. E. S.

MINUTES OF KEGALLE FOOD PRODUCTION COMMITTEE.

Minutes of the Meeting of the Kegalle Food Production Committee held at the Kegalle Kachcheri, on 13th November, 1919.

Present:—The Assistant Government Agent (in the Chair), Boyagoda Mapitigama and Dedigama Ratemahatmayas, Messrs. C. Brereton, R. P. Seneviratne, A. F. Gunaratne (Hony. Secretary) and Crispeyn, Agricultural Instructor.

1. Minutes of the previous meeting read and confirmed.

2. Reports of the Agricultural Instructor for September and October were read and his programme for November approved.

3. Submitted the Director's letter sanctioning the appointment of four additional Agricultural Instructors. Committee approved the selection of four trained teachers and resolved to thank the Director for sanctioning the additional Instructors.

4. Discussed the question of growing beans on ridges of paddy fields. Resolved that Agricultural Instructor should instruct cultivators on his circuits.

5. Seed paddy-Committee thought that there was sufficient seed paddy in the District for next Yala cultivation.

6. Considered letter from Government re Agricultural education in vernacular schools. Resolved that Ratemahatmayas be asked to arrange paddy plots near Government schools on the lease system to be worked by the new Agricultural Instructors and that, subject to the approval of the Director of Education, these paddy plots be attached to Government schools and that the new Agricultural Instructors be asked to give demonstrations to school children.

7. Resolved to write to Government Agent, Western Province and Government Agent, Sabaragamuwa and enquire whether their committees would join in the proposed Agricultural Show at Talduwa, in June, 1920.

8. Resolved that the Assistant Government Agent be requested to insert a condition in chena permits and tickets of occupancy requiring the lessee to plant jak trees.

9. Question of prohibiting the felling of jak trees on private lands was discussed. Resolved to find out whether a prohibition could be enforced either under the village Committee Ordinance or "the Defence of the Colony Regulations."

SOILS AND MANURES.

MANURES.

Comparatively little attention has been paid to the question of manuring in this country, and with the extraordinarily rapid development of food production during the past few months it is hardly to be expected that much would be done in this direction at the commencement. In most cases new land was utilized and the fertility of such soils is generally sufficiently rich to produce one or more good harvests without resorting to manuring. The clays and loams will stand successive cropping and give comparatively good returns for a considerable period without fertilizers while the type of soil usually found on hilly and undulating country more quickly loses its fertility and on it a manuring programme becomes necessary at a much earlier date. The constant removal of crops from the land will sooner or later have a direct influence on the returns and ultimately the soil becomes exhausted. A proper system of crop rotation and thorough cultivation will go a very long way in maintaining fertility and it is perhaps unnecessary to resort to manures until such soils fail to produce average returns in yield.

The type of soil and rotation must be taken into consideration in making a selection of the manures. Light soils require the addition of natural manures to improve their physical condition as well as their chemical state and attention should first be given to building up the soil in organic matter before resorting to artificial fertilizers. This is particularly important in the tropics where very heavy rainfall is experienced and where consequently soluble artificial manures, such as nitrate of soda, are liable to be lost in the drainage water, more especially in light soils.

Improvements as regards actual plant food in a soil can be effected in two ways.

(1) The addition of substances containing plant food.

(2) The addition of substances which may act upon the insoluble compounds present in the soil and render available the plant food they contain. Manures restore the fertility of an exhausted soil and maintain the fertility of land under constant cropping. The immediate effect of a manure depends on its solubility and suitability of the manure for the use of the crop to which it is applied. Soluble manures are immediately available for plant food and should therefore only be applied when crops are on the land otherwise a large part of the fertilizer may be lost in the drainage. Manures which slowly become available may be applied when the land is being tilled. Manures are divided in two classes, natural manures and artificial manures. Organic manures have their origin from vegetable or animal matter. Most of the organic matter in soils is derived from decaying vegetation. The inorganic manures are of mineral origin. The common organic manures consist of farmyard manures (Cattle, horse, sheep, pig, hen, and pigeon dung) guano, fish refuse, sea weed, dried blood, meat guano, bones soot, and oil cakes. The artificial fertilizers are divided into three classes

nitrogenous, potash and phosphatic. The chief nitrogenous manures are sodium nitrate (Chili saltpetre,) ammonium sulphate, calcium cyanamid, and potassium nitrate. Potash manures consist of muriate of potash, the double sulphate of magnesium and potassium, sulphate of potash and kainite (crude sulphate of potassium and magnesium). The common phosphatic manures are—Mineral superphosphates, bone superphosphates and basic slag, while there are a number of miscellaneous manures such as common salt, lime, ferrous sulphate and gas lime.

Organic Manures.—Organic manures, more especially farmyard, improve the physical condition of the soil, making light soils heavier and heavy soils lighter in the same way as green manuring. Farmyard manure is of high value for improving the permanent fertility of a soil as it not only replaces the valuable chemical clements in quantity but also its physical properties cannot be over-estimated. Well rotted cattle manure which has been little exposed to atmospheric influence is the best form to apply. Farmyard manure is not usually available in quantities on estates and in such cases one may substitute other organic manure, for preference horse, goat or poultry manure but guano, bone meal, ground nut cake and poonac are all useful. Guano is of high manurial value but requires to be judiciously used. It is best mixed with 4 to 6 times its weight of earth and applied sparingly to the land. The mixture may be applied at the rate of 4 to 5 cwt. per acre. Guano can be obtained from a number of caves in the limestone formations throughout the Peninsula, where there are considerable stores. There are various forms in which bone may be applied, such as ½ inch bone, bone meal, bone dust, dissolved bone, etc. Bones are considered to have the best effect on soils deficient in lime. Bone manure is used principally as a source of phosphoric acid. The decomposition of crushed bones is slow, varying with the degree of fineness, their fertilizing properties are lasting, while dissolved bones are more rapid in action. Bones are specially beneficial to pasture land but they are generally suitable for root crops. The rate of application of bone meal is 3 cwt. to the acre while that of steamed bone flour is 2 cwt. Poonac or any of the other oil cakes are valuable organic manures and are applied at the rate of about 8 to 10 cwt. to the acre.

Application of Organic Manures.—The time of applying organic manures will depend on a number of circumstances such as the soil, climate and kind of crop, but in this country it may generally be taken that organic manures should be applied when the land is being prepared for a root crop. The manure should be turned under, so as to permit of rapid decomposition, but it is a mistake to bury the manure too deeply in the soil, a depth of about 4 inches can generally be recommended. When a root crop takes its place in a rotation, then an organic manure may be applied when the land is being prepared for the root crop.

Artificial Manures.—One application of an organic manure during a short rotation such as is likely to be adhered to in this country is sufficient and any further manuring required would be on the line of artificial fertilizers. It is unlikely that any rotation, here, will extend over three years in which case one small dressing of a natural manure at intervals of three years is ample, the rate of application being reduced when the period of rotation is less.

(1) *Nitrogenous.*—Nitrates and ammonia salts should either be applied as a top dressing when the plants are young or only shortly after sowing the seed. Nitrate of soda is readily soluble and for this reason is unsuitable for this country as the very heavy rain storms would quickly remove it from the root feeding area. Sulphate of Ammonia is more suitable here, for, although soluble, it is partially retained in the soil. It may be applied at the rate of about 1½ cwt. per acre as a top dressing. Sulphate of Ammonia is a more useful manure than nitrate of soda as it may be used as an ingredient or mixed manures. A cereal crop which is rather backward in the early stages of growth may be stimulated by a dressing of a nitrogenous manure which increases the colour and vigour of the foliage. Potassium nitrate is also an effective form of applying nitrogen.

(2) *Potash.*—An application of a potash manure is of special benefit to land which is deficient in humus and particularly to land which has not been dunged. Clay soils have an abundance of potash for the needs of the plant and do not require further addition of this element. Leguminous crops generally are most benefitted by potash. When applied to cereals it increases the yield to some extent and makes the crop less liable to "lodge." Potash improves the quality of the produce and the cause of spotted leaves is often due to a deficiency of this constituent. Sulphate of potash should contain 50% of potash and is considered one of the best forms for application. Sulphate and muriate of potash are about equal in action and may be applied at the rate of from 1 to 2 cwt. per acre. Kainit is also a common potash manure and may be used at the rate of 2 to 3 cwt. per acre. Potash manures are most effective when applied one or two months before sowing, there is little risk of any serious loss taking place owing to rain.

Phosphatic.—The Malayan soils are, as a general rule, deficient in phosphate. Phosphate manures hasten maturity, have a ripening effect, increase the yield and stimulate the root development in young plants. The common phosphatic manures are mineral superphosphate, bone superphosphate and basic slag. Superphosphates may be applied as a top dressing just before sowing seed, at the rate of about 3 cwt. per acre. Superphosphates are particularly suitable for the growth of root crops and are the best form of phosphatic manure for the lighter class of soils. Superphosphates should not be mixed with any form of lime, basic slag or nitrate of soda. Basic slag is also an important phosphatic manure and acts best on clay soils while it is particularly valuable as supplying a readily available phosphate to soils of an acid nature. Basic slag is applied at the rate of about 5 cwt. to the acre.

Lime and its Application.—One of the chief effects of lime on a soil is to accelerate nitrification and to decompose insoluble potassic minerals in the soil and thus enable plants to draw upon the nitrogenous and potash stores in the ground. It has a neutralizing action on organic acids and thereby helps to sweeten sour soils. Lime has a beneficial action on clay soils by breaking them up, while sandy or light soils are improved by binding the particles together. In order to obtain the full benefits of artificial fertilizers we consider it is essential to apply a small dressing of lime beforehand, this should be done several months previous to the spreading of the fertilizers on the land. There are many soils in Malaya which would, in all probability, respond well to lime treatment. Quick lime is the best form of application,

the lumps being distributed throughout the field and allowed to slake naturally. One night's rain is sufficient for this decomposition to take place but in dry weather it may take several days. The result is a fine dry powder which is found easy to distribute equally over the land. Slaking lime in this country in a large heap and adding water does not appear to give such a fine dry powder as the natural process and the cost of distribution is higher. Lime may be applied at the rate of about 1,500 lb. to the acre. Small applications, at intervals of say three years, are preferable to large dressings at longer intervals.

In the majority of soils it is likely to be found that a small dressing of lime is desirable before placing the land under food production, this is specially important for any leguminous crop.—BULLETIN NO. 30 OF DEPT. OF AGRIC., F. M. S.

INFLUENCE OF TILLAGE ON THE BACTERIA OF SOILS.

Tillage has a direct influence on the activity of soil bacteria. The presence of oxygen is essential for the nitrifying organisms which are responsible for the decomposition of organic matter, therefore tillage, which increases the supply of oxygen, increases the activity of the organisms. The organic matter cannot be used directly by plants, it must be first converted to some soluble form before it is available as food. The nitrogen of the organic matter is converted to nitrites and finally to nitrates which are soluble; this decomposition is due to oxidation and the action of the bacteria referred to. Many of the chemical changes brought about by organisms result in the supply of plant food; hence the importance of thorough cultivation to induce bacterial action. In the absence of air, anærobic bacterial action is induced and this fermentation is unfavourable to plant growth.

Before it is possible to recommend any particular form of tillage, one must be familiar with the type of soil, the past history of the land, the habit and special requirements of the crop. The nature of the surface layer has a direct bearing on the depth and kind of tillage. Where the topsoil is rich in humus and the subsoil poor, it would be most unwise to invert the top layer and bring the subsoil to the surface. If deep cultivation is required under such soil conditions, then, an implement must be used which will stir the land without inverting it. With land recently brought under cultivation deep cultivation should not be practised except under most unusual circumstances. The rich surface layers should be made full use of first before any form of deep tillage is resorted to, this especially applies when growing cereal and pulse crops. The depth of cultivation may very gradually be increased as time progresses. Land which has been brought under cultivation from jungle should have tillage to a depth of about three or four inches for cereals and pulses but in some instances where you have a very friable soil even this light surface cultivation is unnecessary, provided the plants are transplanted from a nursery, but with seed broadcast a slight stirring of the surface is always essential to provide a good seed bed. In opening up grass land, the form of tillage varies with the kind of grass and spread of the root. Grass which has

been grazed on for a year or two or periodically cut, has a shallow root system as compared with grass, more especially "lalang" of undisturbed areas. Grass of the former type may be effiectively eradicated by tillage to a depth of six inches, twice over, with an interval of a fortnight between the applications, and followed by frequent light stirring of the soil to remove the roots. Ploughs may be used for performing the first operation but subsequent teratment and the removal of roots is best undertaken by zigzag harrows and cultivators. With deep rooted grass, as "lalang," the common method of eradication by the changkol is too well known to require description, but it might be mentioned that generally three changkollings of the land, at intervals of about a fortnight are required, the first operation being carried out to a depth of about 15 inches but of course this varies somewhat according to class of soil. The second changkolling is around 8 inches and the final, comparatively shallow. Eradicating lalang in this way is most expensive and objectionable on account of the time, which is often most important, when the land requires to be rapidly cultivated to take advantage of a suitable planting season. With the use of modern machinery such as the tractor, "lalang" may be destroyed by frequent applications of the plough and harrow in such a way as gradually to starve the plant out of existence. This can be done at a small cost as compared with the changkol. The depth and kind of tillage must be such as will suit the particular crop grown. Plants with a shallow root system require shallow cultivation but deep rooted plants, as for instance the root crops must have deep cultivation. From observations made at the Agricultural Reserve, Petaling Hill, Kuala Lumpur, it appeared that deep cultivation for the cereals was objectionable and that the maximum returns were obtained from cultivation to a depth of about four inches. This particularly applies to new land but in later years it is desirable to increase the depth so as to bring up the lower layers in order that they may be influenced by the various agents which render plant food available and thereby replenish the surface layers which may be somewhat reduced in fertility. Poor soils and those which have been under cultivation for many years, should have deeper cultivation than rich productive ones. Cereals are shallow rooted plants and the feeding area for the roots is confined to the surface layers. Within certain limits, the deeper the tillage the more food becomes available for the crop but this can be very much overdone on productive land and especially when growing shallow rooted plants. With root crops deep tillage is essential and when grown on new land, it is of great importance to see that deep stirring does not invert the layers. This can be best overcome by ridging and it has been proved by long experience that root crops grown on furrows give superior yields to those obtained on the flat. There are many advantages derived from ridging, the most important being (1) The root feeding area is increased without drawing, to any extent, upon the sub-soil. (2) The possibilities of the soil becoming water-logged are reduced when the tubers are developed, this is specially important on flat land and particularly when the soil is heavy. (3) The possibility of the tubers rotting is reduced. (4) The yield is increased. (5) The cost of lifting is reduced.

In the tropics, where heavy storms are experienced, it is important to cultivate undulating and hilly land in such a way as to reduce surface wash. This is a great deal more important than is usually recognized and frequently

the damage is done before a remedy can be effected. Once land has lost its top soil, it is a difficult and an expensive matter to bring back the original fertility, which can only be done by growing and turning under green crops and by the application of organic manures. When cultivating land, the final ploughing should always be done in contour with the slope, this also applies to operations with the cultivator and harrow. Any form of ridge, in contour, no matter how small, reduces soil wash. When growing a root crop the furrow must be in contour with the slope.

The turning under of stubble is also of importance. It should be done to a depth which will permit of rapid decomposition but not too deep, otherwise the humus is beyond the reach of shallow rooted crops. In the tropics, from 4 to 6 inches is recommended.—BULLETIN No. 30 OF DEPT. OF AGRIC., F. M. S.

LIME ON FARM LANDS.

TESTING FOR ACIDITY.

During the last two or three years there has been a great deal of interest taken in the question of applying lime to farm lands. It must not be thought that all soils are acid, for some, by reason of their origin, are well supplied with lime. These are almost invariably strong, productive soils, and stock fed on their crops are thrifty, with plenty of bone.

On the other hand, large areas of land are just as naturally poor in this constituent from the outset, and under cultivation the supply is soon so reduced that there is not enough of it to do the work which has apparently been assigned to it in crop production. Stiff clays and wet, low-lying and ill-drained soils are apt to become sour, probably due to the fact that there is little chance for the acid materials found in the soil to drain away. Such soils should be drained first and then limed.

Lime has three main actions in the soil; it neutralises the acids formed, it improves the physical condition, and it is apparently essential for the proper development of certain plants and organisms in the soil.

The acidity of a soil is due to the presence of acids or acid salts, and they may be either organic or inorganic. If this acid is to be counteracted or neutralised, there must be some material of an alkali or basic nature present to combine with the acid and form a neutral salt, and thus destroy the acids formed. This is one of the functions of lime in a soil. If the soil is naturally poor in lime, or has been depleted of its natural store of lime, the soil will probably be sour.

WHY WELL WATER IS HARD.

The natural chemical changes that take place in cultivated soil tend to bring its soluble plant food constituents into a soluble form. These changes are essential to render the food available to the plant. But, among these food constituents, lime, at least, is rendered soluble faster than is necessary for food purposes. Naturally, unless it is again taken up in an insoluble form, it must gradually be carried downwards with the water that sinks into the soil.

For this reason the water of wells and many springs is hard or limey. For the same reason a subsoil contains more lime than a surface soil, and the latter may become so leached that it does not contain sufficient lime to

neutralise the acids formed in the decay of the organic matter when the soil becomes acid or "sour." It is well to remember that the richer the soil is in decaying vegetable matter, and the more thorough the cultivation, the faster the lime will be rendered soluble and leached away. For the same reason, the longer the land has been under cultivation, the faster the lime will be rendered soluble and the more likely it is to need lime.

But the addition of lime does a great deal more than simply neutralise the acid of a soil. It influences the tilth or texture of a soil. This is most marked and most beneficial in the case of clay and clays loams, rendering them less tenacious when wet, and more friable and mellow when dry. This it does by causing the fine particles of the clay to gather into larger units, and makes the soil act more like one made up of larger particles. The flocculation does away with the stiff, waxy, impervious nature common to clays deficient in lime, and renders them drier, warmer, better aerated, with a larger content of moisture available for plant growth. It also brings about a more favourable condition for root development; improves drainage, and permits the farmer to cultivate his clay soil earlier in the spring, with all the advantages that naturally follow.

The action of lime on sandy soils is somewhat similar to that on clay, that is, it binds, or cements, the sand particles together; but the effect on the soil is different. It renders the soil closer in texture, and thus, being less open and porous, it does not dry out so readily in seasons of drought.

A CHEAP TEST.

Many methods have been devised for determining the amount of acid in a soil, but none of these are suitable for field use. In most cases, it is sufficient to ascertain the fact that the soil is acid. For this purpose a fairly satisfactory test can be made with blue litmus paper, which can be purchased at almost any drug store. It is sometimes sold in sheets or in little "books," which contain about twenty-five or fifty strips of the paper, about one half inch wide and two or three inches long. This is the most convenient form in which to have the test paper. If the sheets are purchased, they may be cut into strips the size of those in the books and placed in a clean, dry, wide-mouthed, well-corked bottle to keep them from acid fumes. When this paper comes in contact with an acid it turns red.

A very simple method and a very satisfactory one of applying the test is to make a ball of damp soil, break it open and lay the paper on the broken surface, squeeze the parts together again, and allow to stand for from five to ten minutes.. If on opening the ball it is found that the blue paper has turned red, the soil is acid and in need of lime. It is apparent that the hands must be free from acid and the soil damp enough to press into shape. Unless the soil is very dry, it is generally found that by getting a sample three or four inches below the surface, there is enough moisture to answer the purpose.

If the soil is moderately dry the change in colour may appear only in spots, and greater pressure or longer time may be needed to make a satisfactory test. The rapidity of change and intensity of colour developed indicate to some extent the relative degree of acidity. To overcome accidental difference in the soil, the test should be repeated several times, with samples taken from different parts.—SOUTH AFRICAN SUGAR JOURNAL. Vol. 3, No. 9.

WASTE LIME FROM ACETYLENE MANUFACTURE.

Since the present output of lime and lime product in Britain is far below the quantity that could be economically used for agricultural purposes, it is very desirable that full use should be made of those industrial by-products which contain lime in one form or another. Of these may be mentioned the lime waste from causticising processes in soap and bleachworks, carbonate of lime from munition works, and also the waste lime from the manufacture of acetylene gas. Some idea of the production of these materials may be gathered from the fact that the pre-war consumption of calcium carbide alone equalled about 25,000 tons, which would result in the production of more than 50,000 tons of fresh lime waste per annum.

The main objection to the use of such by-products is that they are generally in a moist condition and in consequence will not bear the cost of transit for long distances. On the other hand, they are largely produced in industrial districts, and it is exactly in these localities that, owing to the continued action of acid fumes from the air, the soil frequently becomes sour, and its productive power suffers in consequence.

Waste Lime from Calcium Carbide.—It is common knowledge that when water is allowed to act on calcium carbide, or carbide of lime, an energetic production of acetylene gas takes place and a residue of slaked lime is left, together with a little dissolved acetylene and any impurities which the commercial carbide may have contained. In general, the amount of the impurities is not likely to rise very high, since it is to the interest of the makers to attain as great a degree of purity of product as possible, but some amount of uncertainty has attached to the possible harmful effect of traces of sulphides and sulpho-cyanides which have been detected from time to time. With the object of ascertaining whether these impurities were present in sufficient quantity to exercise any deleterious effect on plant growth, experiments were carried out last season by three institutions—Oxford University, Leeds University and Rothamsted—at the request of the Food Production Department. The results of the inquiry are given below.

At Oxford and Rothamsted the experiments were made by means of pot-cultures; at Leeds, garden plots were used. In the case of pot-culture experiments, the general scheme allowed of a comparison between carbide waste and finely-divided calcium carbonate, (a) applied one month before sowing. (b) Applied immediately before sowing. A third portion was allowed to weather by exposure to the atmosphere for one month before application. The material for the experiments was part of a consignment of fresh carbide waste supplied to the Department by a large firm of acetylene manufacturers. It was received in a metal drum, and during transit a certain amount of free liquor had been expressed. This was drained off, and the lime was subjected to a partial drying and sieving before being despatched to the other centres.

Oxford Experiments (PROFESSOR SOMERVILLE).—The experiments were carried out in duplicate with two different soils. Unfortunately, the crop yields of the duplicates showed very great variation, and it is doubtful whether the calculation of the mean crop weights would serve any useful purpose. It may be mentioned, however, that the heaviest crop in each of the two series was given, in one series by soil treated with carbide waste at the rate of 1·0 per cent. at the time of sowing, and in the other series by soil treated with 5·0 per cent. of carbide waste one month before sowing. With neither of the soils was there any definite evidence of injury by the applications.

Rothamsted Experiments (DR. H. B. HUTCHINSON).—Three series of tests were carried out. In the first series, carbide waste was applied to an acid

soil at the rate of 0·5 per cent. (3·3 tons per acre—top 6 in.). The treatments and the yields are given below:—

	Mean Dry Weight of Crop.
Control	0·65 grms.
Calcium Carbonate, applied one month before sowing ...	27·10 ,,
Carbide waste, applied one month before sowing ...	27·35 ,,
Calcium Carbonate, applied at time of sowing ...	25·05 ,,
Carbide waste, applied at time of sowing	28·35 ,,
Carbide waste, exposed one month,* applied at time of sowing	22·90 ,,

The value of carbonate of lime and of the carbide waste was therefore practically identical, whether applied one month before sowing, or at the time of sowing.

Two sets of germination tests were also carried out. In these the carbide waste was applied at the rate of 1·0 and 3·0 per cent. of the soil, respectively, i.e. 6·6 and 20 tons of lime per acre (top 6 in.). Barley and mustard seeds were sown immediately after treatment, and gave the following mean germinations. In the presence of 3·0 per cent. of carbide waste germination of the seeds was slightly retarded, but after ten days the results were identical with those of the control plots :—

	Control.	1·0 per cent. Carbide Lime.	3·0 per cent. Carbide Lime.
Barley 12 seeds)	10·5	10·5	10·5
Mustard (20 seeds)... ...	18·5	19·5	18·0

The three series thus indicate that when carbide waste is well broken down it may be applied in fairly large quantities without giving rise to injurious effects.

Leeds Experiments (DR. HANLEY).—The work was carried out on a light coal-measures loam, with plots 1/1,200th of an acre in area. One plot served as control, a second received carbide lime at the rate of 3 tons per acre, and the third received an equivalent quantity of ground chalk.

The applications of lime and chalk were made on 30th April, and on 1st May the plots received a dressing of fertiliser at the rate of 4 cwt. of superphosphates and 1 cwt. of sulphate of ammonia per acre. Barley was sown on the latter date. Germination was normal throughout, and during the growing period there was no noticeable difference between the carbide waste and chalk plots. Both the limed plots showed a marked superiority over the unlimed plot from the start, and this was greatly accentuated by the drought. This affected all three plots, but very few plants on the control plot survived it. The crop was cut on 20th September, and gave the following results :—

	Weight of Barley in Green Condition Straw and Grain.
Control plot	100 grms.
Carbide waste plot	4,800 ,,
Chalk plot	4,900 ,,

The results are thus in accord with those of the experiments reviewed above.

In practice the main difficulty attending the use of such industrial residues arises from the wet condition in which they are produced, but this difficulty may be surmounted, and fairly efficient incorporation of the lime with the soil achieved, by making the application in autumn, winter or early spring, and allowing the lime to weather down and become friable. Moderate dressings would be at the rate of about ½ cwt. per rod.—JOURNAL OF BD. OF AGRIC., Vol. XXV, No. 10.

* (Sample flooded during exposure).

PESTS AND DISEASES.

AN OUTBREAK OF BLACK ROT IN UPPER ASSAM.

A. C. TUNSTALL, B.Sc.

In the third issue of the Quarterly Journal last year a description was given of a fungus disease called Black Rot which attacks tea in Southern India and Ceylon and causes serious damage there. In July this year a serious outbreak of this disease has occurred on two or three gardens in Upper Assam. There is evidence to show that the disease was present on one of these gardens last year, and it is probable that it was also to be found on others. The dull wet weather which has been so prevalent this season apparently favours the distribution of the disease with the result that it spread over a considerable area. At first the managers of the gardens concerned thought that the disease was merely Grey Blight, but as it was spreading so rapidly one of them sent specimens to Tocklai. As soon as the disease was identified the manager was informed by wire and instructed to remove and burn all the diseased shoots. This work was put in hand at once and as soon as possible afterwards the Mycologist visited the garden taking with him a number of spraying machines. The disease apparently originated in an old seedbari which had been cut down. From this it had spread over about sixty acres of tea of which twenty were severely attacked; the remainder had groups of diseased bushes here and there. At first sight the disease resembled Grey Blight but the diseased leaves adhered to one another wherever they happened to be in contact. Although the diseased patches on the leaves were generally grey in colour, there were none of the black dots characteristic of Grey Blight. Examination with the lens showed that there was a very thin film of fungus spreading over the under-surface of the leaves. Microscopic examination showed that the fungus was wholly external, in which respect it resembles Thread Blight. No spores were found and it was obvious from the manner in which the attack had taken place, that the distribution had not been by means of spores. The bushes were large and well-grown and in most cases in contact with their neighbours. The fungus had spread from bush to bush and the distribution had been aided by the coolies, working in the tea, rubbing against the diseased bushes thus transferring the fungus from bush to bush. The manager had pruned a number of the diseased bushes and burnt the prunings. This had checked the disease but was rather drastic. It was found that the careful removal of the diseased leaves and dead shoots followed by the application of Lime Sulphur solution checked the disease satisfactorily. The badly infested area was treated all over. In order to economise labour only the diseased bushes and those in their vicinity were treated in the slightly affected areas. The two rows of tea on either side of the roads leading from the infected areas

were dusted with sulphur with the aid of dusting machines. A neighbouring garden was also infected with this disease. In this case as it was impossible to treat the whole area infected it was decided to isolate that area as much as possible and treat all outbreaks on the other sections as soon as they were noticed. The infected area will be treated in the cold weather by removing all the diseased leaves and pruning out of dead shoots. On this garden, it is interesting to note that the distribution of the disease was obviously aided by the coolies passing from section to section. After returning to Tocklai the Mycologist received specimens of this disease from another garden in Upper Assam, and it would seem probable that quite a number of gardens are infected. At present the fungus does not seem to produce any spores but it is impossible to say that it will not do so. It is therefore important that it should be eradicated as soon as possible. It is capable of doing very considerable damage even with its present limited methods of distribution. Should they be increased by the formation of spores it would possibly be a more serious disease in Upper Assam than Blister Blight is in Darjeeling. Fortunately the gardens in Upper Assam are very carefully cultivated and it should be possible with a little care to prevent this disease getting a serious hold.

The disease is caused by a fungus called *Hypochnus theae* or a very nearly allied species. The following characteristics distinguish this disease from others, such as Grey Blight, Brown Blight, and Copper Blight.

1, As a general rule there are no spots on the grey patches. There may be a few spots caused by other fungi living on the dead tissue.

2. The leaves and twigs adhere to each other at points of contact.

3. Examination with a lens shows a very thin film of fungus on the undersides of leaves freshly attacked.

When this disease is suspected specimens should be sent at once to Tocklai, meanwhile the diseased leaves should be plucked off, carried away in bags and destroyed. It should be arranged so that coolies will not have to pass from the diseased bushes direct to work in other disease-free areas on the garden.

At the present time there is no need for serious alarm. In spite of the exceptionally favourable weather the disease has not spread to a very great extent, and unless it produces spores, it does not seem likely to do very serious damage if a reasonable effort is made to keep it in hand. The fungus was found in damp corners on the Cachar bheels by the Mycologist some years before but as no specimens have ever been received at Tocklai from that district it may be assumed that the disease has not caused any serious damage.—Quarterly Journal of Indian Tea Assn., Part III. 1918.

BEAN AND PEA WEEVILS.

Stored grains and cereal products are subject to attacks by several kinds of insects in the Tropics, to such an extent as to interfere seriously with the growing of these crops. The planter does not care to grow large quantities for storage because the loss from weevils is so grea

As a safeguard against a certain amount of such loss there have been established in Antigua and St. Vincent, under Government control, drying machines in which Indian corn has been conditioned. In St. Vincent in particular, maize has been treated for the purpose of drying out excess moisture, and thereby preventing the growth of moulds and mildews, and also for the purpose of killing the insects in the grain. This, with proper arrangements for storage in insect-proof bins, constitutes a measure of protection against insects and fungi in stored grains, and it may be applied to those species which infest peas and beans, as well as the "weevil" and other pests in maize. The trouble experienced in storing seeds and grains is not confined to tropical regions. All temperate countries have the same trouble in greater or less degree.

The United States Department of Agriculture recently (September 1918) issued FARMERS' BULLETIN, No. 983, entitled Bean and Pea Weevils, by DR. E. A. BACK and MR. A. B. DUCKETT, and the Department of Agriculture, Union of South Africa, at the same time issued a similar publication, Bulletin No. 12, 1918, entitled Pea and Been Weevils, by MR. S. F. SKAIFE, B. A.

It is significant that at a time like the present, when the demand for foodstuffs is pressing and the need for conservation great that these two great agricultural countries, one in the north temperate and the other in the south temperate zone, should be dealing with the same group of insect pests in order to help the growers and others to save as much as possible of the valuable leguminous grains.

The weevils which attack beans and peas in the West Indies appear to be of three species: the bean weevil (*Bruchus obtectus*), the cowpea weevil (*B. chinensis*), and the four-spotted bean weevil (*B. quadrimaculatus*). The injuries resulting to peas and beans in storage from the attacks of these insects is usually attributed to weevils, without distinguishing between the several species. It would appear likely, however, that the cowpea weevil is the most abundant in the West Indies. The pea weevil (*B. pisorum*) is sometimes to be found, but it probably is merely imported with peas from northern localities, and does not breed here. Several other species of the genus Bruchus are recorded as occurring in the West Indies, but they do not seem to be known as pests of cultivated peas and beans.

The three species mentioned above as being of importance in connexion with the seed of cultivated leguminous crops are all alike in the essential points of their life-history, habits of feeding, and method of control. They all begin their attack in the young developing pod in the field. The insects in the seed at the time of harvesting continue breeding in storage, and if left uncontrolled will, by successive attacks, completely destroy the seeds.

Bean and pea weevils, like many other insect pests, pass through several marked changes in form and habits before reaching maturity. The adult weevil that is seen crawling about among the seeds is the parent insect. Many of these fly from the storage room or house to the fields where beans and peas are growing. As the bean and pea pods develop, the mother weevil lays whitish eggs, either on the outside or within the pods. These eggs are so small that they are often not noticed for they appear as mere white specks upon the pods. From these eggs there hatch white grubs that burrow their way through the pods into the soft developing beans and peas. Because these grubs are so very tiny, the holes through which they enter the

seeds are too small to be seen, unless one searches for them with a microscope. Usually beans become infested first when they are nearly full grown. As seeds expand and harden in the final ripening process, the holes in the skin through which the grubs entered become less and less easy to find. The wound in the skin either becomes entirely healed over or remains similar in appearance to a pin prick.

"Since beans and peas mature much faster than the weevil grubs within them, it happens that the weevil grubs are comparatively small or little developed in many instances when the crop is harvested and placed in storage. Thus many seeds that appear outwardly in excellent condition, in reality have weevil grubs hidden away in their interior." (FARMERS' BULLETIN, No. 983).

In this way the beans or peas become infested, and when harvested they contain living insects which will shortly emerge as adult beetles; these will deposit eggs, and another generation will attack the beans or peas. The injury caused by the first generation of the cowpea weevil and four-spotted bean weevil is not very great, but when the attacks are allowed to continue unrestricted during the whole time these seeds are in storage they may be entirely destroyed. Although cowpeas are the preferred food, most kinds of peas and beans are attacked. The FARMERS' BULLETIN, No. 983, mentioned above, gives the following list of food plants for the cowpea weevil :—cowpea, common pea, pigeon pea, lentil, check pea, mung bean, and common white bean. In this list the mung bean is the woolly pyrol of the West Indies.

Nearly every one who has kept seed of leguminous plants for any length of time in the West Indies knows the effect of the work of these insects. From a monetary point of view the loss is greater in these districts, particularly in the temperate climate, where large areas are grown in leguminous crops for sale and shipment to the markets of cities and towns. The Bulletin (983), already mentioned, states that One Province of Canada alone suffered from ravages of the pea weevil to the extent of over $1,000,000 in a single year. It was estimated in 1902 that the acreage of field peas in Ontario would have been 1,000,000 instead of the 532,639 actually planted, had it not been for the fear of the pea weevil.

The situation in the West Indies is more comparable to that existing in the Southern State, where cowpeas are cultivated for their great value as soil covers and soil improvers, as well as for use for fodder, and where the acreage grown under this crop would be probably very much greater, but for the serious losses resulting from the attacks of these weevils.

These notes will be concluded in the next issue of this Journal.—AGRIC. NEWS, Vol. XVIII., No. 452.

CASUARINA AND MANGROVE BOTH ATTACKED BY THE SAME BORER.

According to an article in the JOURNAL OF ECONOMIC RESEARCH, Washington, D.C., Vol XVI, No, 6, the casuarina which has been extensively planted in Florida has been seriously attacked by the mangrove borer (*Chrysobothria tranquebarica*, Gmelin). Casuarina is a tree of much value for planting in the West Indies, and deserves to be more used than it has been in the past; the mangrove and its borer occur in some of these West Indian islands. On this account the article mentioned is summarized herewith for the benefit of readers of the *Agricultural News*.

The red mangrove (*Rhizophora mangle*, L) is a native of the West Indies and perhaps also of Florida. The mangrove borer, also a native of the West Indies, is recorded as occurring in Cuba, Porto Rico, and Guadeloupe. It was known to science as long ago as 1787, but it appears that nothing was known previously with regard to its various stages, seasonal history, habits, etc. It has been known in Florida since 1886, but it is only within the past three or four years that it has been recognized as a pest of casuarina.

The adult beetle is a small insect of a metallic greenish-bronze colour. The female measures from 13·5 to 17 mm., and the male 12·5 to 14 mm. in length. Both sexes are fond of bright sunlight and are commonly found flying from 10 a.m. to 3 p.m. They feed on the tender, succulent bark of trees they infest.

The eggs are inserted under the thin outer layer of dry bark of the mangrove. When the eggs hatch the larvæ bore into the soft bark to the wood where they remain feeding on the cambium until nearly full-grown; at this stage the larva bores into the wood and excavates the pupal cell and provides a tunnel by means of which the adult insect will make its way to the outer world as a beetle.

One year is required for the development of the mangrove borer from egg to adult. So far as is known, this insect attacks only living red mangrove and the casuarinas. It is not a borer in dead wood.

In Florida both these trees have been killed by this borer, and the killing out of the tops or the main stem and forcing growth into the branches producing a stag-head effect appears to be a characteristic form of injury.

The pest may be controlled in casuarina by scraping the bark and digging out the grubs, and by spraying the stems with a poisoned oil emulsion, made according to the following formula :—

Standard miscible oil	...	...	1 pint
Water	...	...	5 gallons
Sodium arsenate	...	...	½ lb.

Dissolve the arsenate in water, stir, then add 1 pint of miscible oil. Casuarina trees in infested localities should not be pruned from April to August, as the flow of sap will attract the flying beetles to the tree.—AGRIC. NEWS, Vol. XVIII, No. 453.

THE MINIMUM BORDEAUX APPLICATION FOR THE CONTROL OF HEMILEIA.

The principal obstacle to coffee production in the Philippines for some years having been found to be leaf rust (*H. vastatrix*) an investigation has been made of this disease, the results of which are tabulated and discussed.

A stock solution of 3 : 5 : 50 Bordeaux was used at 25, 50, and 75 per cent of its full strength. The 75 per cent solution employed every three weeks gave fair results, as did the 50 per cent. strength employed every two weeks. Weaker solutions or longer intervals gave slight protection and were employed at a loss. It was shown that for the best results spraying should begin before the infection is perceptible. Caracolille coffee on the college farm was infected earlier than was native coffee at San Antonio. A net profit from spraying was obtained on two lots of coffee at Los Banos.—EXPT. STATION RECORD, Vol XL, No. 8.

CO-OPERATION.

RURAL CREDIT IN THE PHILIPPINE ISLANDS.

MR. A. W. PRAUTCH, Chief, Rural Credit Division of the Department of Agriculture and Natural Resources of the Philippine Islands has very kindly sent us a copy of an article written by him on the above subject for the Mid Pacific Magazine of Japan. It contains an interesting account of the history and the progress of the Rural Credit in the Philippine Islands and valuable information for those who are interested in the co-operative movement.

The Rural Credit Law (No. 2808) of the Philippine Islands was enacted to remove the restriction in the Corporation Law (No. 1549) requiring $200,000* paid up capital before a bank can be started and to provide rules and regulations which would ensure the operation of credit banks or associations and safeguard the interest of the small investors, the general public and the Government.

The associations may incorporate with a paid up capital ranging from $100 to $10,000. Those who pay for shares become members and the members elect a Board or Committee of five who manage the affairs of the associations. They elect new members, collect share capital, issue loan and borrow money on behalf of the association. Only one association can be incorporated in a Municipality. This, it is said, is to avoid rivalry and factions. Provision has been made in the Act to the effect that the bonded municipal treasurer shall act as treasurer *ex officio* without any extra remuneration and that the Government Auditor shall audit the accounts. This provision has inspired the simple cultivators with confidence in the bank and MR. PRAUTCH states that no other single feature has contributed more to the success of the movement than this provision to protect the funds of the association.

All payments are made by the Treasurer on vouchers passed by the Board of Directors. No individual member can own more than $500 worth of shares and each member has only one vote irrespective of the number of his shares.

The associations enjoy the following privileges until the paid up capital of each association attained $10,000, viz., exception of taxes or revenue charges, of stamp fees and registration fees of mortgages and other documents and the Court fees on the collection of unpaid debts.

The organising staff of officers are paid and maintained by the Government. The office-bearers of an association work gratuitously and on no pay. But on the other hand the Government furnish no financial help directly or indirectly, and the supply of forms, books, etc., have to be paid for by the associations. This is generally met by the association by a levy of a small entrance fee from each member thus aiming at self-help.

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* $10=£1.

MR. PRAUTCH then goes on to give a description of the working of the plan of rural credit in practice which seems to be quite practicable.

The organising staff visit towns, distribute copies of the Act and point out benefits the whole community would reap if the small farmer can keep for himself the usurious interest now exacted for the loans he must have. It is also pointed out how this interest would stay in the town instead of going to the hands of the capitalists and the money thus collected would go to form their own bank as a result of this co-operative effort. Thus an association is formed and a description of the method of organisation of an association and its registration is given In coming to the business principles of the association, MR. PRAUTCH says that the loans are given by these associations only on the personal surety though there is provision to lend on mortgage of landed property, pledge of animals, etc. The associations admit only persons of good character thus reducing the number of refusals for loans and encouraging the earnest and industrious farmers as members.

When the paid up capital of an association is $1000 or over the association is permitted to borrow from the National Bank a sum equal to its paid up capital on the security of its capital and a note signed by the five directors is given. The National Bank also lends out larger amounts to associations on the joint and several security of the growing crops, stored produce, work animals, sugar mills, etc. of the members. The Bank charges 8% to the association and the association lends out to members at 10% the profits going to the association.

The progress of the movement has been phenomenal. The first association was registered in October, 1916 and in May, 1919 there were 325 registered associations and over a hundred in various stages of organisation. The paid up capital of all the associations at the time of registration was $164,846 and at the latter date it stood at over $400,000. There were over 30,000 members who had paid for shares. Loans amounting to $350,000 have been given to some 6,000 members. Apart from these ordinary loans the Rural Credit Associations have been successful in the grant of loans to responsible persons for the purpose of encouraging the cultivation of rice and corn. A million *peses* have been placed at the disposal of the associations for this purpose and the associations act as agents. So far applications for a sum of $800,000 have been received and a sum of $212,600 has been lent out. It is gratifying to note that there were no failures to speak of and the majority of associations work successfully. One association which was started with a paid up capital of $94 has within 18 months $10,000 of working capital. This example of self development convinced one that principles of co-operation is adapted to the people and the people adapt themselves to the co-operative principles.

Among the co-operators there are women farmers, Roman Catholic priests, hundreds of teachers, officials and citizens who do their bit to improve the associations and communities. MR. PRAUTCH in conclusion of his valuable article testifies to the good work done by those in the towns who were willing to sacrifice their time and use their influence for the propagation of the movement which should serve as an object lesson to Ceylon.

N. W.

GENERAL.

THE RÔLE OF SCIENCE.

It has been said that the rôle of science is prophecy. In the sense of revealing natural law and its manifestations, this is another way of saying that the rôle of science is to enable prediction regarding the operations of natural phenomena under definite conditions. For science enables the relation between cause and effect to be traced, determines the response to specific influences and conditions; and since the knowledge it establishes is exact and unvarying it becomes possible to prophesy with certainty what will take place when certain conditions meet. The statement therefore expresses broadly the final function and attribute of science.

But beyond this, science is at once the source of exact knowledge and the means by which it is advanced. It supplies a background in accumulated information, and it permits a glance into the unknown which enables further advances to be made. It thus broadens the vision of problems and their nature, stimulates speculation, and suggests courses of action which may be productive. These are essentials of prophecy in respect to natural manifestations, without which there could be no progress in science.

Progress is the keynote of science. Science is never complete; it is in continual process of being added to. An answer suggests further questions and may reveal a possible means of solution. Science is therefore constantly searching, building new theories, advancing its boundaries step by step, making prophecy more sure. Investigation which is not thus characterized falls short of its purpose.

Science not only contributes substantial facts but it discloses more clearly the real nature of complex problems, making their solution more feasible; and it propounds new ones which are practicable of productive study. To propound problems and to analyze and define their character are important functions of science. These are first steps in the direction of progress, for they provide a starting point and a clearly defined purpose.

In agriculture it has acquired long years of research to lay bare the real underlying questions and suggest how they might be approached. The starting point was naturally provided mainly by general science, but it required special insight to develop out of the traditions and practices of this ancient art the scientific aspects of the underlying problems; to show, for example, what factors were actually involved in the growing of crops and the feeding of plants. The conditions prevailing in successful practice had to be studied, data accumulated extensively under a variety of circumstances, and the results of certain definite combinations recorded. Gradually a background of fact was accumulated which although imperfectly understood gave an insight into the situation and served as a basis for specific investigation.

The ultimate solution of an agricultural question may prove to be a relatively easy task after the real nature of the question is understood. This was the case with the problems of cheese making and curing, for example,

after the actual factors involved had been made clear and separated so that they could be studied. For many years there was great confusion in discovering and developing the laws of heredity, but MENDEL taught that success depended in fixing attention, not on the organism as a whole but upon one after another of its various attributes or characters. Thus disintegrated, the problem of inheritance became simplified and susceptible of solution by the ordinary methods of experiment.

The understanding of what is fundamentally involved in a complex question of practice is still a necessary first step. It is the rôle of science in agriculture to disclose this in order that the solution may be unfolded and prophecy made possible.

* * * *

There is a distinction between what it might be desirable to do in the interests of science and practice and what it is feasible to accomplish at the present state of knowledge of problems and technique. Questions are frequently brought to the attention of the stations which it is not practicable to solve at present, either because there is not sufficient background to enable the problem to be understood or the methods and technique are deficient. Investigation cannot successfully progress much faster than the methods and means of study advance, and often not more rapidly than investigation in the domain of general science clears the field and enables hypothesis and theory to be advanced.

* * * *

It will be recognized that there are many subjects, like studies in breeding with plants and animals, the physiology of nutrition, the effects of soil treatment, the working out of intricate questions of disease, etc., which necessarily require long and persistent study and cannot be hurried. They may or may not be ultimately rewarded with success. There are others which require the systematic accumulation of data under a variety of conditions and over long periods. But in neither case does this warrant limitation to routine effort or neglect of technical features which will be ultimately essential.

* * * *

The process of investigation is progressive in insight, in approach and in method. It develops with the opening up of the subject by the results secured and those of other contemporary investigation. If the work is not progressive in this sense it is not a searching inquiry and critical study, but a methodical and more or less mechanical accumulation of data. If it does not advance step by step in the effort not only to contribute to the evidence but to perfect the attack, it misses the essential feature of research and proceeds on a mistaken estimate of the necessarily inherent value of data covering long periods. Experimental data are of value to and a part of investigation as they are applied to it. Already we have a broad background for investigation in most common subjects in agriculture. It is not necessary to spend time exclusively or mainly in taking data which may serve at some future time as the basis for research. The problem and the specific question are already at hand if we can discern them.

To cite a familiar example, it has long been known that land can be cropped continuously for a long time, often with surprising returns, and that fertility or productive capacity may be maintained and even improved by

combinations of cropping systems, fertilizers, and soil treatment. Whether or not this is fundamentally true is no longer a question for lengthy experiment; the general truth is now matter for demonstration. The economic phase may need some development and local adaptation, but the underlying question for research lies beyond this point. It concerns the reasons, the changes in conditions and relationships which are brought about, the reciprocal relations of various classes of factors which are in operation, the means of maintaining the proper balance in these factors, and matters of this sort. These are not solved by growing and harvesting crops in rotation through a long period, even if the greatest possible care is observed, or by the chemical analysis of the crops and of the soils at intervals of several years, or even by sampling the plats occasionally for the usual bacteriological examination. Rotation and fertilizer experiments of themselves seem at present to be contributing relatively little that is new regarding the theory of plant feeding, soil fertility, and soil management. It is where such series of experiments are being utilized to study certain definite questions of limited range that they are productive of new light.

It is the purpose and use which give life to the taking of data and make their acquisition profitable. Correlation studies, for example, proceed through long periods and result in volumes of data, but unless they are interpreted in relation to some problem they do not directly advance knowledge, and a point is soon reached where their accumulation lacks the elements of research.

* * * *

Intensive and concentrated effort is the price of success in agricultural research. To be productive it requires close application with critical attention to the accuracy and the meaning of the results. It is an intensive, diligent application of the powers of inquiry. Intermittent, fragmentary effort arrives late, if at all. It is uneconomical of the station's funds, and its encouragement breeds a habit which is detrimental to highest efficiency.

* * * *

It is important to avoid losing sight of the fact that productive investigation calls for a type of training which instils the idea of the essentials of research and its methods, as well as provides a store of knowledge as a foundation for it. The former is not less important than the latter to give originality, initiative, judgment, and authority. Unless these can be insured agricultural investigation can not measure up to expectations, and science will not fulfil its rôle of prophecy.—EXPT. STATION RECORD, Vol. 40, No. 8.

AGRICULTURE AT THE BRITISH ASSOCIATION.

In his address to Section M., PROF. SOMERVILLE pointed out that during the war the area of land in the United Kingdom under grass was reduced by more than three million acres, with a corresponding increase of the area under tillage crops. Even were this increase of cultivated land maintained there would still remain more than 30 million acres under permanent and temporary grass, exclusive of about 16 million acres of mountain land used for grazing. Several attempts have been made to discover a relationship

between the botanical composition and the feeding properties of permanent pastures, but the results have been largely negative; neither has it been possible by chemical analysis to differentiate between grass of poor and of high quality. The only trustworthy test of quality that can be applied would appear to be through the agency of animals consuming the produce of the meadows or pasturing the fields. This work was initiated at Cockle Park in Northumberland in 1897, and has been extended to some twenty other experimental stations in various parts of the United Kingdom and in New Zealand. It has been conclusively proved that poor grass land is susceptible of rapid and profitable improvement, especially through the agency of phosphates. In many cases the stock-carrying capacity of land has been more than doubled, while the progress of the individual animals has also been largely increased, so that the output of meat or milk from land suitably manured has often been trebled or quadrupled with advantage to the nation and substantial profit to the farmer. One conspicuous result of experiments on manuring-for-meat has been the long-continued action of dressings of phosphate, 200 lb. per acre of phosphoric acid in the form of basic slag still producing very marked effects at the end of nine years. Nitrogen, potash, and lime as an addition to phosphates have been tried at several stations, but in most cases with comparatively little effect. Indirect manuring through feeding stock with cake has also given unsatisfactory results.

Research during recent years has been directed towards discovering how the marked improvement secured by an initial dressing of phosphate can be maintained, and it has been found that in no way can the maintenance of fertility of pasture be better secured than by means of supplementary dressings of phosphate.—NATURE, Vol. 104, No. 2602.

BOTANY AT THE BRITISH ASSOCIATION.

SIR DANIEL MORRIS began his address to Section K by remarking that since the Association met at Newcastle in 1916 there has been decided progress in every branch of science, and also a fuller recognition of the value of science and education as means whereby the material interests of the world may be enlarged. A new branch of botany has lately come into prominence as one of the results of the devotion to nature study and the contemplation of the characteristic features of vegetation as we find it distributed over the world's surface. Ecology is capable of enormously extending the outlook of botany, and it has so largely added to the interest of field work that we may wonder that the phenomenon of vegetation so long displayed before our eyes had not suggested its sociological aspects long ago. It is hoped ecology will mitigate some of the admitted drawbacks of purely laboratory work and revive the old natural history spirit of former days.

Travelling somewhat outside the scope of previous addresses, an attempt was made to summarise the results of the many efforts to promote not only the interests of the homeland, but of the Empire as a whole. The establishment of an Imperial Department of Agriculture in the West Indies, followed by similar highly equipped departments in India and in such tropical colonies

as Ceylon, Mauritius, Federated Malay States, Fiji, and in East and West Africa, has greatly advanced scientific research on the applied side in connection with sugar, cotton, indigo, rice, india rubber, and other important industries. The admirable work done by BIFFEN at Cambridge and the HOWARDS in India in raising new and improved varieties of wheats clearly demonstrates the value of thorough acquaintance with pure botany as a qualification for grappling with questions of economic importance.

As a result of BIFFEN's plant-breeding work at Cambridge, new wheats have been produced and grown over extensive areas in the eastern countries that have yielded crops at the rate of 50 to 60 bushels per acre. In one instance an area of a little over twenty-seven acres has yielded 2,072 bushels, or an average of 77 bushels per acre. This is to be compared with the average yield of wheat in this country at about 32 bushels per acre. The new whats are not only more productive, but are less liable to disease, and the quality of the flour is superior to that of ordinary English wheats. In regard to India it is estimated that the Pusa wheats raised by the HOWARDS will shortly be established over five million acres, and it is anticipated that they will bring in an increase in the value of the agricultural produce of India, in one crop only, of 75 lakhs of rupees of five millions sterling.

HENRY'S researches in regard to hybrid trees and his elaborate investigation into the history of the London plane were generally regarded as valuable contributions to science. It was claimed in the case of many trees that it is possible to produce much greater bulk of timber in a given time; while, according to DAWSON, the common belief that quickly grown timbers are of an inferior quality is said not to hold good in respect of any quality in ash, oak, and walnut.

It is widely felt that the most pressing of all investigations at the present time is the study of plant diseases. The recently established Institute for Plant Pathology at Rothamsted may be the means of introducing entirely new methods in mycological investigations.

It was further suggested that all research work should be organised on the broadest possible lines and combine the biological services of the whole Empire. We have a first step in this direction in the Imperial Bureau of Entomology with its headquarters at the British Museum. Those acquainted with the efficient work done by this bureau, and the valuable publications issued by it, will heartily welcome the establishment of the proposed Imperial Bureau of Mycology, at Kew, to carry on work on similar lines.—NATURE, Vol. 104, No. 2602.

SPONTANEOUS COMBUSTION.

So called 'spontaneous combustion' in reference to such things in ships' cargoes, as coal, cotton, hay, tobacco, and cacao is a subject of considerable importance in the tropics. The JOURNAL OF THE ROYAL SOCIETY OF ARTS for June 20 contains a paper on the subject, read by MR. WATSON SMITH, F. I. C., before the Society. This paper begins by explaining that spontaneous combustion arises by reason of such chemical and physical changes in bodies,

mostly consisting or containing carbon, and under the influence of atmospheric oxygen, that sufficient heat is generated to give rise ultimately to combustion. In a general way the most frequent places of spontaneous combustion occur in coals and not many years ago the German Government, after an elaborate inquiry, declared that more ships were lost through such outbreaks than through any other cause. It is noted that coal, containing throughout its mass pyrites, is most inclined to fire when in a damp state. This should cause certain precautions, such as observations of temperature at certain periods to be regularly taken.

Another substance in which fires may arise through the gradual generation of heat is quick lime. It is well known that if water be suddenly added to quick lime there is a rapid generation of heat, and this may be quite enough to set fire to dry material or inflammable substances in close proximity. Owing to its physical properties charcoal is liable to fire. It has been found by experiments that finely ground charcoal placed in a barrel attained a temperature of 75°C. after fifteen hours; after twenty hours ignition took place. This was due to the absorption of oxygen and a certain quantity of water. This circumstance might be borne in mind in connexion with the transmission of seed like cacao or rubber in damp charcoal from one part of the tropics to another. If transmitted in large quantities it should be quite possible for enough heat to be produced to kill the seeds, if not to set fire to the parcel.

The statement that wet cotton is liable to break out in combustion is improbable, but a spark getting into a bale will smoulder for a long time, and the fire eventually occurring will then be probably stated as having been due to spontaneous combustion. Greasy cotton is undoubtedly dangerous, most fatty oils absorbing oxygen rapidly with the generation of much heat. A case is recorded in which a firm received a consignment of Indian cotton damaged with river water, and it was offered for sale by auction. On the auction day, the cooper observed that a number of bales had burst several of their encircling iron bands, and the heating of the cotton was perceptible. Investigation showed that these bales contained an extraordinary proportion of cotton seeds. The germination of the seeds in the bales could not proceed, but the heat produced was enough to cause expansion of the air, and to raise the temperature very nearly high enough to set fire to the cotton.

In the case of tobacco, fermentation is frequently the cause of combustion. Also in the case of ensilage there is some danger of overheating. Care should be taken in West Indian islands where silos have been erected, to institute a proper routine for checking the temperature from time to time. In regard to such substances as dried fish, guano, and bone dust, it is recorded that on one occasion a few hundred tons of such material were landed from a ship at Glasgow, and at once placed in bulk in a store on a stone floor. In a short time the material began to heat internally, and so it was opened out and spread more thinly over the floor by a gang of men, this of course bringing the heated stuff more in contact with the oxygen of the air. While this spreading out was taking place a large quantity of the material took fire, and before extinction could be effected a portion of the enclosure was destroyed.

Amongst the acids the most dangerous are sulphuric acid and nitric acid. As ships' freights, the carboys in straw should be stored with great care, and enclosed either under deck or on deck with sand so that should the safety of the ship demand it, they can be readily thrown over the side.—AGRIC. NEWS, Vol. XVIII, No. 452.

PRESERVING FRUIT.

Fruit may be preserved without sugar by the following methods :—

(1) In special glass jars with screw tops. These should be filled with fruit and water, almost to the top. The lid and screw should then be loosely put on, and the jars placed in cold water up to the neck. The water should be slowly heated to 180 deg. Fahr., and the bottles then removed, placed on a wooden table or board, and the lids screwed up firmly. It is an additional safeguard to the sterilisation, and an aid to the subsequent removal of the lid, if a little grease, such as lard, be run inside the screw.

(2) In ordinary glass jars, which also should be filled almost completely with fruit and water. Then a piece of soft wet bladder should be tied on the top, and the bottles submerged in water and heated to 180° F. Fruit thus preserved may be stewed, or made into puddings, with a small quantity of the cheap sugar which is unsuitable for the making of jam.—WEALTH OF INDIA, Vol. VIII, No. 9.

SORGHUM AS A COLOURING MATERIAL.

According to M. PIEDALU, the "glumes" or husks of sweet sorghum and those of sorghum with black seed, hitherto of no use at all, yield a gum with very fine shades of color ranging from pink to bright red, salmon, scarlet, pearl gray, dark gray, dark brown and khaki, all colors which, being sun and soap proof, are highly suitable for dyeing wool, silk, leather and vegetable fibres. The discovery of this new dyeing material, it is stated, is one of great importance, and steps are to be taken to work it on a large scale.—WEALTH OF INDIA, Vol. VIII., No. 9.

CARBOLIC ACID AND SCORPION STINGS.

DR. C. G. DHANDHUKIA DEVLALI.

I have found none of the remedies as yet recommended in the treatment of scorpion stings so efficacious as the application of pure carbolic acid to the site of the sting.

I have tried it in very many cases during the last seven years and been satisfied of its efficacy and noticed that it gave almost instantaneous relief in every case and secured complete freedom from all the symptoms of the sting in from 2 to 5 minutes.

The application in some cases, may have to be repeated, three minutes after the first if all symptoms have not by the time disappeared.

I consider it a duty to bring this efficacy of the acid in scorpion stings to the notice of the profession.—WEALTH OF INDIA, Vol. VIII, No. 9.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED 30th NOVEMBER, 1919.

Province, &c.	Disease	No. of cases up to date since Jan. 1st. 1919.	Fresh cases	Recoveries.	Deaths.	Balance Ill.	No. Shot.
Western	Rinderpest	957	96	158	732	32	35
	Foot-and-mouth disease	259	16	259	—	—	—
	Anthrax	—	—	—	—	—	—
	Rabies	4	1	—	4	—	—
Colombo Municipality	Rinderpest	671	120	—	—	—	—
	Foot-and-mouth disease	8	—	—	—	—	—
	Anthrax	16	3	—	—	—	—
	Rabies	27	2	—	—	—	—
Cattle Quarantine Station	Rinderpest	80	—	—	—	—	—
	Foot-and-mouth disease	12	—	—	—	—	—
	Anthrax	350	13	—	—	—	—
Central	Rinderpest	436	30	85	350	1	—
	Foot-and-mouth disease	127	18	127	—	—	—
	Anthrax	7	—	—	7	—	—
	Rabies	11	—	—	11	—	—
Southern	Rinderpest	10	—	3	7	—	—
	Foot-and-mouth disease	2287	—	2264	19	4	—
	Anthrax	49	25	—	49	—	—
Northern	Rinderpest	96	—	25	64	—	7
	Foot-and-mouth disease	580	—	416	35	129	—
	Anthrax	76	—	—	76	—	—
Eastern	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	1212	—	1071	141	—	—
	Anthrax	7	—	—	7	—	—
North-Western	Rinderpest	237	46	45	170	5	17
	Foot-and-mouth disease	435	8	408	12	13	2
	Anthrax	—	—	—	—	—	—
	Rabies	2	1	—	2	—	—
North-Central	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	852	—	838	14	—	—
	Anthrax	28	—	—	28	—	—
	Rabies	1	—	—	1	—	—
Uva	Rinderpest	16	4	8	8	—	—
	Foot-and-mouth disease	4481	—	4497	52	32	—
	Anthrax	—	—	—	—	—	—
	Black Quarter	15	—	—	15	—	—
Sabaragamuwa	Rinderpest	329	7	16	273	—	40
	Foot and-mouth disease	538	84	523	2	13	—
	Anthrax	—	—	—	—	—	—
	Rabies	1	—	—	1	—	—

Colombo, 4th December, 1919. E. T. HOOLE, Acting G.V.S.

METEOROLOGICAL.

NOVEMBER, 1919.

Station	Temperature: Mean Daily Shade	Temperature: Difference from average	Mean Humidity	Mean amount of cloud 0=clear. 10=Overcast	Mean Wind Direction during month	Daily Mean Velocity	Rainfall: Amount	Rainfall: No. of Rainy days	Rainfall: Difference from average
	°	°	%			Miles	Inches		Inches
Colombo Observatory	79·6	0	82	7·2	W	95	8·89	18	- 2·05
Puttalam	79·3	+ 0·1	84	6·0	SW	103	7·18	15	- 2·99
Mannar	80·8	+ 0·4	82	7·9	Variable	87	15·93	19	+ 5·78
Jaffna	80·0	+ 0·6	85	6·2	Variable	108	18·71	18	+ 4·43
Trincomalee	80·6	+ 0·6	—	—	—	—	11·40	20	- 2·54
Batticaloa	80·4	+ 0·9	79	6·5	Variable	71	8·19	18	- 4·76
Hambantota	80·0	+ 0·5	79	5·8	SW	189	3·38	12	- 3·36
Galle	79·2	0	84	7·2	WNW	181	9·31	20	- 2·00
Ratnapura	79·1	- 0·8	80	6·8	—	—	19·68	23	+ 5·55
Anu'pura	78·8	0	80	7·6	—	—	11·65	22	+ 1·34
Kurunegala	78·3	- 1·3	80	7·7	—	—	15·15	20	+ 4·27
Kandy	74·6	- 0·9	80	8·4	—	—	14·36	23	+ 3·96
Badulla	71·6	- 0·8	83	7·4	—	—	9·02	21	- 1·54
Diyatalawa	67·4	+ 0·4	76	6·7	—	—	8·63	22	- 0·92
Hakgala	59·9	+ 0·3	84	8·2	—	—	9·27	24	- 1·99
N. Eliya	59·2	+ 0·1	84	8·4	—	—	7·99	22	- 0·99

Upcountry, generally, to the West of the Hills and centrally up to the extreme North of the Island the rainfall was heavier than usual. This excess being greatest to the West and North of the Hills. The greater portion of the Eastern half of the Island, the South and West experienced less rain than usual. The number of rainy days experienced was larger and the clouded state of the sky heavier than usual. Humidity was decidedly low to the East but about normal elsewhere.

On the whole, the temperature and the wind both in direction and force did not vary greatly from normal.

Atmospheric pressure was slightly in deficit.

J. E. EVANS,
Acting Supdt., Colombo Observatory.